# 2011PAKISTAN PROGRAMMATIC UMBRELLA PERSUAP

## PESTICIDE EVALUATION REPORT AND SAFE USE ACTION PLAN

**NOVEMBER 2011**

This publication was produced for review by the United States Agency for International Development. It was prepared by Weidemann Associates Inc. The authors are Dr. Alan Schroeder and Dr. Aamer Irshad.

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## PESTICIDE EVALUATION REPORT AND SAFE USE ACTION PLAN

Contract Number AID-OAA-TO-00017
RAISE-PLUS Agricultural Knowledge and Program Support

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# ACRONYMS

| | |
|---|---|
| ADB | Asian Development Bank |
| ADP-B | Area Development Programme-Balochistan (UNDP) |
| AESA | Agro Eco System Analysis |
| AID | US Agency for International Development (also known as USAID) |
| AJK | Azad Jammu Kashmir |
| ANE | Asia and Near East Bureau of USAID |
| APO | Agricultural Pesticides Ordinance (Pakistan) |
| APTAC | Agricultural Pesticides Technical Advisory Committee (Pakistan) |
| AVC | Agriculture Value Chains Project |
| BEO | Bureau Environmental Officer |
| BMP | Best Management Practice |
| BT | *Bacillus thuringiensis* (type of microbial-extract pesticide) |
| CABI | Commonwealth Agriculture Bureau International (now known as the British Consortium for Overseas Pest Management) |
| CEC | Children's Ecological Clubs (Pakistan) |
| CEQ | Center on Environmental Quality |
| CFR | Code of Federal Regulations |
| CIBC | Commonwealth Institute of Biological Control |
| CIB & RC | Central Insecticides Board & Registration Committee (India) |
| cm | centimeters |
| CRAMS | Contract Research and Manufacturing Services |
| CWA | Central and West Asia (part of CABI) |
| DFP | Dried Fruit Project |
| DPP | Department of Plant Protection (Pakistan) |
| EA | Environmental Assessment |
| EC | Emulsifiable Concentrate (a pesticide formulation) |
| EPA | US Environmental Protection Agency (also known as USEPA) |
| EIS | Environmental Impact Statement |
| EMMPR | Environmental Mitigation and Monitoring Plans and Reports |
| ETL | Economic Threshold Level |
| EU | European Union |
| FAO | Food and Agriculture Organization (part of UN) |
| FATA | Federally Administered Tribal Area |
| FIFRA | Federal Insecticide, Fungicide and Rodenticide Act |
| FFS | Farmer Field School |

| | |
|---|---|
| g | grams |
| GAP | Good Agriculture Practices |
| GDP | Gross Domestic Product |
| GlobalGAP | Global Good Agricultural Practices |
| GIZ | Gesellschaft für Internationale Zusammenarbeit (Germany) |
| GOP | Government of Pakistan |
| GMO | Genetically Modified Organism |
| HCl | Hydrochloride |
| HMIS | Hazardous Materials Identification System |
| HPAI | Highly Pathogenic Avian Influenza |
| HPED | Highly Pathogenic and Emerging Diseases |
| HT | Highly Toxic |
| IC | International Consultant |
| ICAMA | Institute for the Control of Agrochemicals of the Ministry of Agriculture (China) |
| ICARDA | International Center for Research in the Dry Areas (Syria) |
| ICRISAT | International Center for Research in Semi-Arid Tropics (India) |
| ID | Identification |
| IEE | Initial Environmental Examination |
| IGR | Insect Growth Regulator (a class of insecticide) |
| I-LED | Improving Livelihoods and Enterprise Development Program |
| IMF | International Monetary Fund |
| IPM | Integrated Pest Management |
| IVM | Integrated Vector Management |
| IWM | Integrated Weed Management |
| LDP | Livelihood Development Program |
| MAIL | Ministry of Agriculture, Irrigation and Livestock (Afghanistan) |
| MDGs | Millennium Development Goals |
| MEO | Mission Environmental Officer |
| mg | milligrams |
| MINFAL | Ministry of Food, Agriculture and Livestock (Pakistan) |
| MNC | Multi-National Corporation |
| MOH | Ministry of Health (Pakistan) |
| MRL | Minimum Residue Level ('safe' amount of pesticide on sold food) |
| MSDS | Material Safety Data Sheet |
| MT | Moderately Toxic |
| NAT | Not Acutely Toxic |
| NARC | National Agricultural Research Centre (Pakistan) |
| NARS | National Agricultural Research Systems |

| | |
|---|---|
| Nat-IPM | National Integrated Pest Management Programme (Pakistan) |
| NCCW | National Council for Conservation of Wildlife (Pakistan) |
| NEPA | National Environmental Protection Act (USEPA) |
| NGO | Non-Governmental Organization |
| NWFP | North West Frontier Province |
| OAPA | Office of Afghanistan &Pakistan Affairs |
| OP | Organophosphate (a class of pesticides) |
| PAN | Pesticide Action Network |
| PARC | Pakistan Agriculture Research Council |
| PC | Pakistani Consultant |
| PER | Pesticide Evaluation Report |
| PERSUAP | Pesticide Evaluation Report and Safer Use Action Plan |
| PIC | Prior Informed Consent (a treaty, relates to risky pesticides) |
| PMP | Pest Management Plan |
| PNT | Practically Non-Toxic |
| POPs | Persistent Organic Pollutants (a treaty, relates to toxic pesticides) |
| PPE | Personal Protection Equipment |
| PPMT | Production and Pest Management Plan |
| PVO | Private Volunteer Organization |
| R&D | Research and Development |
| RBM | Roll Back Malaria Program (UNWHO) |
| REI | Restricted Entry Interval |
| Reg 216 | Regulation 216 (USAID Environmental Procedures) |
| RNE | Royal Netherlands Embassy |
| RUP | Restricted Use Product (Pesticide) |
| ST | Slightly Toxic |
| SUAP | Safe Use Action Plan |
| TOF | Training of Facilitator |
| TOT | Training of Trainer |
| UC | University of California |
| UK | United Kingdom |
| ULV | Ultra Low Volume (spray technology) |
| UN | United Nations |
| UNDP | United Nations Development Programme |
| UNFAO | United Nations Food and Agriculture Organization |
| UNWFP | United Nations World Food Program |
| UNWHO | United Nations World Health Organization |
| US | United States |

| | |
|---|---|
| USA | United States of America |
| USAID | United States Agency for International Development |
| USEPA | US Environmental Protection Agency (also known as EPA) |
| USG | United States Government |
| VHT | Very Highly Toxic |
| WFT | Women Facilitators Training |
| WBG | World Bank Group |
| WHO | World Health Organization |
| WOS | Women Open Schools |
| WWW | World Wide Web |

# EXECUTIVE SUMMARY

This 2011 Pakistan Programmatic Umbrella PERSUAP was developed for and under the direction of the USAID Mission in Pakistan via Prime Contract Number AID-OAA-TO-00017 for Agricultural Knowledge and Program Support Task Order, Work Assignment 13 through Weidemann Associates Inc.

This “programmatic umbrella” approach was used to economize resources such that each USAID Pakistan project would not need to duplicate costs to produce their own PERSUAP report. Moreover, the objective is to have one document which can guide activities where pesticides are or could be involved in any USAID project in Pakistan. The PERSUAP is intended to comply with 22 CCR 216 and ensure the safe procurement of pesticides, use and/or recommendation for use in USAID-funded programs and activities, and provide binding SUAP for implementation.

At the same time, the document provides project implementers in each sector where pesticides will be or might be used with the most common risks likely to be encountered for that sector. It contains or references recommended mitigation measures and international best practices to reduce risks. Projects can then use these risk-mitigation pairings to inform and guide their own development of risk monitoring, mitigation and reporting plans, as USAID requires.

To be clear, the main purpose of a Pesticide Evaluation Report (PER) and Safe Use and Action Plan (SUAP) is to bring USAID-funded projects into compliance with USAID’s environmental regulations (Title 22 of the Code of Federal Regulations (CFR), part 216, or Regulation 216)) on pesticide use. Beyond compliance, this document offers best practices and helps ensure that the USAID-funded projects reduce the chances of environmental and health impacts due to pesticide training, promotion or use.

Risks are inevitably present with the use of pesticides and similar chemicals in several sectors including agricultural crop and livestock production, water treatment, avian influenza disinfection, construction and malaria prevention. In addition to required compliance, there is an acute focus on the use of Good Agriculture Practices (GAPs) and Integrated Pest Management IPM) pest prevention tools.

For the purposes of this PERSUAP, the word *pesticide* is used, following EPA’s guidelines[1], for the following: fumigants, insecticides, miticides/acaricides, nematicides, molluscicides, fungicides, antimicrobials, bactericides/biocides, microbicides/antibiotics, herbicides, rodenticides, avicides, algicides, ovicides (kill eggs), disinfectants/sanitizers and anti-fouling agents (chemicals that repel or kill things like barnacles that attach to boats). Even biological agents such as biopesticides, microbial pesticides, attractants/pheromones, repellents, defoliants, dessicants and insect growth regulators and plant growth regulators are included as pesticides.

[1] http://www.epa.gov/pesticides/about/types.htm

It is important to note that farmers can—with their own funding—buy and use whatever pesticides are legally available in Pakistan, as long as they are not part of a USAID project, not used in USAID-procured equipment, and the treated produce does not enter a USAID-funded program. USAID projects can promote, purchase or donate pesticide training, pesticides and equipment as long as the risks associated with such goods and services have been evaluated in a PERSUAP.

Before errors (such as human poisonings) occur, it is the responsibility of USAID project implementers to put these mitigation recommendations into action, Implementers will then monitor changes in risks, impacts and mitigation success using EMMPRs (Environmental Mitigation and Monitoring Plans and Reports). Finally, the implementers will report positive or negative changes from baselines as a measure of mitigation success in semi-annual reporting instruments.

This report begins with country and project background sections followed by a section which evaluates risks across the agriculture inputs sectors in Pakistan. After the Introductory and Background sections demonstrate the potential risks to beneficiaries, farmers and their resources, and the use of best practices, then the PER section addresses the 12 informational factors (a through l) required in the Agency's Pesticide Procedures, under 22 CFR 216.3 (b)(1)(i). Finally, the SUAP puts the conclusions and recommendations reached in the PER into a plan of action. The USAID Project is then expected to assign responsibility for each recommendation to appropriate staff members as delegated on the EMMPR, and develop a timetable and a budget for doing this.

This PERSUAP study and its useful Annexes and References were informed by findings from field trips to project sites, identifies risks and fills some information and knowledge gaps where pests, IPM and pesticides are concerned. It also helps ensure (along with implementation of recommended mitigation/monitoring/reporting measures, and USAID audits) compliance.

## IMPORTANT PAKISTAN CROPS AND LIVESTOCK

Since the Pakistan agriculture sector is a primary and major user of pesticides, it takes the lion's-share of space in this document. This PESUAP, then, focuses on the following list of major crops/livestock produced in Pakistan and likely to receive USAID support (note that cotton and tobacco—also important in Pakistan—are almost never supported by USAID):

- **Cereals/Small Grains:** Rice; Maize/Corn; Wheat/Winter Wheat; Barley/Winter Barley
- **Oil and Seed Crops:** Rape Seed/Canola; Mustard; Groundnut/Peanut; Sunflower; Safflower; Sesame; Linseed
- **Sugar Crops:** Sugarcane; Beets
- **Pulses:** Chickpea and Lentils; Mashbean; Urdbean; Green peas; Beans
- **Solanaceous Crops:** Tomato; Potato; Chilies; Eggplant/Brinjal
- **Cole Crops/Crucifers:** Cabbage; Cauliflower; Broccoli
- **Cucurbits:** Cucumbers; Squashes; Pumpkins; Melons; Watermelon
- **Okra**
- **Alliums:** Onions
- **Brassicaceous:** Turnips; Radish

- **Forage/Fodder legumes:** Alfalfa/Lucerne; Clovers/Sainfoin/Espartset; Vetches; Trefoils
- **Stone Fruits/Drupes:** Apricot; Peach; Almond
- **Pome Fruits:** Apple; Pear; Loquat; Quince
- **Pomegranate**
- **Mango**
- **Citrus**
- **Grapes**
- **Guava**
- **Dates**
- **Banana**
- **Papaya**
- **Livestock:** Cattle; Buffalo; Sheep; Goats; Donkey; Horse; Camel

## PERSUAP FINDINGS THAT INDICATE RISKS FROM PESTICIDES

For this study, it was assumed that in order for project field staff and beneficiaries using USAID resources to properly, safely and correctly provide advice to cooperating farmers during demonstrations and training, at a minimum they should understand:

- Primary pests impacting each project-supported sector, activity or crop
- Integrated Pest Management (IPM) tools and tactics used to prevent primary pests of project-supported activities and crops
- Pesticides that can be used for each primary pest of a given sector
- USA and Pakistan pesticide registrations
- Risk issues like acute and chronic toxicities with commonly-used pesticides
- PPE (Personal Protection Equipment) recommended for specific pesticide uses

Field visits and interviews by a contracted local Pakistani pesticide expert showed that not all of the above assumptions hold for most Pakistanis. The expert did field visits to various sectors in Pakistan that could receive USAID support, and interviewed the Government of Pakistan officials, farm stores that sell seeds, pesticides, fertilizers and farm tools, and potential cooperating beneficiaries who will require inputs through local pesticide distributors. Most farm stores were found to be well organized, as recommended, with pesticides separated by use type (insecticide, fungicide and herbicide).

Generally, with the exception of the malaria and Highly Pathogenic Avian Influenza sectors, scarce quantities of PPE are likely to be found, or used. Most pesticide users including small- and medium-scale farmers rarely use PPE other than boots, long pants, a shirt and a hat, and therefore many farm stores do not stock gloves, respirators, and goggles. Respirator masks that were encountered in farm stores contained sponge filters, which stop dusts and some mists, but not volatile organic vapors. The best masks for protection from pesticide vapors contain carbon filter media.

Training is also significantly lacking. Beyond recommending and procuring PPE, Pakistani Implementing Partners, demonstration farmers and other beneficiaries will need to be trained in useful IPM tools and tactics as well as pesticide safe use best practices. Furthermore, pesticides not registered by EPA and highly toxic pesticides (Class I) are found in the region, and in Pakistan. And, toxic and banned pesticides like endosulfan and methyl-bromide are still found registered and used throughout Pakistan.

## THE PERSUAP STUDY FOCUS ON IPM, PMPs AND PESTICIDES

The practice of IPM – the use of which is considered to be a policy of USAID[2] – is fully supported and promoted in Sections 1.5 of this PERSUAP as well as in the required PER Section 3.3 Factor C analysis. USDA supports the use of IPM through regional centers[3], and through the development of Pest Management Plans (PMPs)[4]. Moreover, Annex 1 of this PERSUAP presents off-the-shelf IPM and GAPs researched and extended to farmers and other sector pest control personnel in other countries, particularly the USA and other developed countries, for the very same or similar crop-pest combinations as those found at project implementation locations. These IPM tactics (which include pesticides registered and used in the USA for the same sectors, activities or crop-pest combinations) are presented for project field managers and beneficiaries to test and adopt, as is practical and desired.

Further, the crop-pest-GAP/IPM/pesticide information in the 64-page Annex 1—the heart and soul of the document—is meant to provide project staff and beneficiaries with a solid starting point for developing their own locally-adapted PMPs for each crop. A guide for making detailed PMPs is provided in Annex 2, and it is expected that the implementing partners will work with demonstration farmers, farm managers and other beneficiaries to prepare PMPs and pest management posters or flyers to assist in the prediction and prevention of damage caused by specific pests and crop production constraints.

Annex 3 provides an updated adaptation of an outline of important IPM program elements funded by USAID and developed by FAO[5], and implemented quite successfully in Indonesia in the 1980s. These 10 timeless elements are offered to project field managers to consider for planning purposes in developing and implementing IPM strategies.

This PERSUAP focuses strongly on GAP and IPM tools including commercialized natural pesticides containing Active Ingredients (AIs) extracted from plants, microbes, marine organisms, spices and minerals (see Annexes 4 and 5) as well as cultural practices and synthetic pesticides used in the USA, some of which are available in CAR countries, or could be made available in the future as crop production diversifies.

Annex 6 shows important differences between EPA's and World Health Organization's (WHO) systems for classifying acute human health risk, and references the Russian acute toxicity system. Following this is Annex 7 which compiles all of the AIs in pesticides (natural and synthetic) found in or likely to enter Pakistan, from or through any of the neighboring countries, broken down by Tables covering each of the seven focus

[2] USAID.1990.Integrated Pest Management: A.I.D. Policy and Implementation
[3] http://www.csrees.usda.gov/nea/pest/in_focus/ipm_if_regional.html
[4] http://www.ipmcenters.org/pmsp/
[5] http://www.communityipm.org/Countries/indonesia.htm

sectors of this PERSUAP. Project decision-makers—especially those who interface at the field level with beneficiary demonstration farmers—are encouraged to look at the label of potential pesticide choices to determine the AIs contained in them. Then, use this Annex 7 as a quick reference guide to attributes of—and issues with—each chemical.

The pesticide attributes in Annex 7 include pesticide class (to manage resistance by rotating chemicals from different classes), EPA registration and Restricted Use Pesticide (RUP) status (to comply with Regulation 216) and acute toxicity (judged by this document to be safe, or not, for small-holder farmers—most Class I chemicals are not considered safe for smallholder farmers to use). Annex 7 also presents chronic human health issues, water pollution potential, and potential toxicities to important non-target organisms like fish, honeybee pollinators, birds, earthworms and several aquatic organisms.

Further, the pesticide AIs in Annex 7 are broken down by "approved" pesticides shaded in green and those that may be approved given that certain conditions are met shaded in yellow. Pesticide AIs not approved are shaded in red (and reasons for rejection are to be found in the data contained in the matrix—either the chemical is in not registered by EPA, is found in RUP pesticide products or uses, is highly toxic Class I, is a known carcinogen or known water pollutant). Following this matrix, chemicals shaded in yellow are hot-linked to specific web pages in order to guide users to current RUP (and non-RUP) information about each product containing the chemical.

Annex 9 of this report synthesizes training topics that should be covered by ACT, and Annex 10 provides a field monitoring form for farmer best practices, including GAP and IPM options and pesticide use monitoring forms, and Annex 11 provides references and websites used to produce this PERSUAP.

Thus, this programmatic umbrella PERSUAP provides useful tools for evaluating and choosing among IPM options (including pesticides) while adhering to 22 CFR 216, as well as many of the rapidly-evolving international and market-driven Best Management Practices (BMPs) found throughout Standards and Certification (S&C) systems like Organic, Fair Trade, GlobalGAP and others. Below are the key best management practices and recommendations synthesized from the PER, and found in the SUAP.

## HOW TO USE THE PERSUAP EFFICIENTLY

Most USAID-funded projects will focus on one or a couple of the seven sectors covered by this Programmatic Umbrella PERSUAP, and many agriculture projects will focus on just a handful of crops. The best way to use this document then is to focus on the parts that apply to the sector desired, and ignore the rest. To do this efficiently, search this document for the specific target sector(s), crops or even pests (common or scientific name) using the Word computer program's "Find" feature, which allows one to enter the word or phrase desired, and then takes one to the exact parts of the report where the word or phrase is emphasized or used. Pesticide active ingredients, and in Annex 1, commercial names can be found using the same method.

## UPDATE THE REPORT ANNUALLY AND AMEND THE REPORT IN TWO YEARS

It is important to note that the development of new pesticides, new EPA and international pesticide regulations and registrations, as well as new international market requirements for pesticide residues on food are all highly dynamic, changing every couple of months. For that reason, and others, this PERSUAP should be updated—at least annually— and amended after two years to remain current and accurate.

To do an annual (2012) update, USAID/Islamabad would contact a PERSUAP expert to make a Purchase Order or other agreement for about 10 days of work. The PERSUAP expert would then contact each current USAID project in Pakistan to collect information on pesticide usage and mitigation measures in place. Further, the expert would then examine and analyze the newest pesticide regulations, changes, and registered pesticides. And, the expert would re-examine the pesticide system in the country and any new pests that have been reported.

After two years (2013), the report should be completely amended to cover all new changes to the pesticide system, from registration to new pests, new EPA pesticide registration changes and new control systems or tactics.

## PERSUAP RECOMMENDATIONS FOR MITIGATING RISKS

### IMMEDIATE ACTIONS RECOMMENDED FOR SAFETY

Perform IPM and Safe Pesticide Use training (on two or more occasions to ensure that training sticks) for all Pakistan assistance project implementers and beneficiaries that use or procure pesticides with project assistance (see Annex 10).

Obtain recommended PPE for all Pakistan assistance project implementers and beneficiaries that use or procure pesticides with project assistance (see PPE websites referred and linked to herein).

Pakistan assistance projects ensure that implementers and beneficiaries do not procure or use certain pesticides containing the Active Ingredients shaded in red in Annex 7 with USAID assistance; perform EDD (Environmental Due Diligence) and provide training and recommendations for avoiding any use of such pesticides; perform EDD and require that assisted enterprises show progress to complying with Pakistan law as a condition for receiving project assistance other than training.

Pakistan assistance projects use lists of pesticides analyzed herein to match pesticide commercial product names with each of the Active Ingredients found shaded in red in Annex 7; make a list for Annex 7 and distribute this list to each Pakistan assistance project implementer.

Ensure that each Pakistan assistance project implementer has a copy of the list of pesticides currently available or likely to become available, for use in Pakistan (these are all listed in Annex 1 with both Active Ingredient (AI) and product names and Annex 7 with pesticide AI names only) and understands their use.

Pakistan assistance projects make efforts to obtain, as available, copies of the Material Safety Data Sheets (MSDS) for each of the pesticide products used by beneficiaries on Pakistan assistance projects. See MSDS at:

http://www.bayercropscience.com.au/resources/uploads/msds/file7219.pdf.

Translate into a local language the most critical PERSUAP sections and Annexes for a more efficient use of PERSUAP findings.

## ACTION RECOMMENDED BY MAY 2012

Pakistan agriculture assistance projects work with the Pakistani MAWR&PI to make provisional PMPs for each Project crop (use Annexes 1, 2 and 3 as well as local farmer knowledge) so managers and farmers have a tool to predict, prevent and manage pests throughout the season (see PMP examples at http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html, website upper left "Year-Round IPM Programs").

## CONTINUOUS ACTIONS RECOMMENDED FOR SAFETY AND BMPS

Pakistan assistance projects implementers do hands-on and work shop training that encourages project-assisted farmers to use PPE, pesticide safety best practices and apply pesticides only during the appropriate times of day (early morning/late afternoon, low wind, no rain).

Once Government of Pakistan begins to register pesticides anew, Pakistan assistance projects check the list of registered pesticides every 6 months to obtain new pesticide registrations & regulatory changes.

As Pakistan registers them, or they become available, and when the use of pesticides is required to achieve project goals, Pakistan assistance projects implementers promote commercially-available pesticides containing natural chemicals listed in Annexes 4 and 5.

For all demonstrations, Pakistan assistance projects implementers introduce pesticide record-keeping concepts and tools following GlobalGAP or other internationally-accepted BMP procedures.

## PROGRAM MANAGEMENT ACTIONS ON COMPLIANCE

Pakistan assistance projects monitor beneficiary farmers for their understanding and use of best practices found in the field form in Annex 11.

Pakistan assistance projects report on monitoring in Annual Reports to USAID COTR and MEO, under a heading titled "Environmental Mitigation and Monitoring".

Pakistan assistance projects implementers report on any changes in Pakistan pesticide regulations and registrations.

Annually participate in the amending of this PERSUAP to contain new IPM/Integrated Vector Management (IVM) tactics and any new pesticides registered or available.

Pakistan assistance projects write the names of pesticides that cannot be used with USAID assistance into any future grant or sub-contract.

Pakistan assistance projects environmental staff members include relevant actions drawn from this SUAP in EMMPRs or draft an EMMPR containing pesticide issues identified in the SUAP, with ways to mitigate the most common risks.

# SECTION 1: INTRODUCTION

## 1.1 INTRODUCTION TO USAID ENVIRONMENTAL COMPLIANCE

From 1974 to 1976, over 2,800 Pakistan malaria spray personnel were poisoned (5 to death) by insecticide mishaps on a USAID/WHO anti-malaria program[6]. In response to this and other incidents arising from USAID programs, a law suit was brought by a coalition of environmental groups for USAID's lack of environmental procedures for overseas projects. USAID, in response to the law suit, drafted US 22 CFR 216. This regulation, which was updated in 1979 to include extraterritorial affairs in response to changes in the scope of the application of the National Environmental Policy Act (NEPA) now guides most USAID activities that could have potentially negative environmental impacts.

Regulation 216 (also called Part 216) of 22 CFR states that certain environmental compliance processes and procedures must be followed on overseas projects in order to:

- Respond to market demand for clean, high-quality agricultural produce, and meet import expectations
- Create modern state-of-the-art development
- Achieve optimal economic results with every dollar invested
- Avoid harming people in both our partner countries and the US
- Avert unintended negative economic growth
- Reinforce practical civil society and democracy through transparency and public participation
- Reduce diplomatic incidents
- Engender public trust and confidence in USAID
- Comply with the law
- Represent good business.

[6] http://www.ncbi.nlm.nih.gov/pubmed/74508

## 1.2 USAID'S REGULATION 216

According to Regulation 216, all USAID activities are subject to analysis and evaluation via – at minimum – an Initial Environmental Examination (IEE), and – at maximum – an Environmental Impact Statement. For projects with low potential environmental impacts an Environmental Mitigation Plan and Report (EMMPR) may be sufficient, while for projects with larger potential impacts an Environmental Assessment (EA) may be required.

A large part of Regulation 216 – part 216.3 – is devoted to pesticide use and safety. Part 216.3 requires that if USAID is to provide support for the use of pesticides in a project, 12 pesticide factors must be analyzed and recommendations be written to mitigate risks to human health and environmental resources. This plan must be followed up with appropriate training, monitoring and reporting for continuous improvement on risk reduction and adoption of international best practices for crop production, protection and pesticide use safety is strongly encouraged.

## 1.3 THE PESTICIDE EVALUATION REPORT & SAFER USE ACTION PLAN (PERSUAP)

In the USA, the EPA can rely on the following safety-enhancing factors, not present to the same degree in most developing countries—including Pakistan:

- An educated literate population of farmers and other pesticide users
- Quality IPM information and Pest Management Plans (PMPs)
- A well-functioning research and extension or other system to extend IPM information to farmers and other pesticide users
- Certification systems for farmer training on restricted and other pesticides
- Quality affordable PPE to reduce pesticide exposure
- Quality pesticide labels and Material Safety Data Sheets (MSDS) to guide farmer safety
- Accurate information and training on pesticide use, transport, storage and disposal

Because of the differences in infrastructure and resource availability, USAID and US regulations require location specific analysis of pesticide use in developing countries, and development of procedures to ensure safe use.

In the late 1990s, USAID's Bureau for Africa (AFR) developed the PERSUAP—a tool to analyze the pesticide system or sector in any given country or territory. The PERSUAP focuses on the particular circumstances, crops, pests and IPM/pesticide choices of a project or program. This "systems approach" analyzes the pesticide sector or system from registration to import through use to disposal, and develops a pesticide risk profile based on the analysis.

A PERSUAP is generally recommended by and submitted as an amendment to the project IEE or an EA. It requires approval by the BEO/OAPA. Further, the application of PERSUAP recommendations helps prepare project participants to be able to more rapidly adopt BMPs, GlobalGAP, Organic and other S&C systems principles, as desired, for future market access.

## 1.4 ANALYSIS OF PERSUAP PRECEDENTS FOR PAKISTAN

In 2007, a PERSUAP was drafted for the Improving Livelihoods and Enterprise Development (I-LED) Program for earthquake-affected parts of Pakistan, including Siran and Kaghan Valleys located in the North West Frontier Province (NWFP) and Bagh District located in Azad Jammu Kashmir (AJK). I-LED linked crop production in these areas to markets with economic growth potential. One part of I-LED focused on the sustaining and increasing production of basic grains, vegetables, oil and fiber crops, fruits and nuts. Access to agriculture inputs, especially pesticides, was considered essential. The PERSUAP analyzed all of the target crops, pests and all pesticides registered in 2007 by the Government of Pakistan (GOP). At that time, numerous highly toxic, Class I chemicals were still registered by Pakistan for import and use. This included azinphos-methyl, carbofuran, dichlorvos, and endosulfan, in addition to banned pesticides entering Pakistan illegally. In 2007, IPM information from the region was sketchy and very basic IPM practices were recommended for various crop-pest combinations.

In 2009, a PERSUAP was drafted for the Pakistan Livelihood Development Program for the Federally Administered Tribal Area (FATA-LDP) project. It covered organizations to develop consortiums, alliances and partnerships to implement a social and economic stabilization and development program impacting the seven Agencies of FATA and the six bordering Frontier Regions. One component of LDP was community-based programs comprised developing new farm service centers and other sustainable businesses, including agriculture production, processing to add value and marketing.

The FATA-LDP Program and PERSUAP covered basic grains, vegetables, oil crops, fruits and nuts grown in FATA as well as pesticides registered in Pakistan in 2009. At the time, IPM information from the region was sketchy and very basic IPM practices, excluding pesticides, were recommended for various crop-pest combinations. From 2007 to 2009, the number of highly toxic and banned pesticides entering Pakistan declined, due more likely to lack of international markets and thus lack of banned pesticide manufacturers than to increasing control by GOP. Endosulfan, produced primarily in quantity in India, continued to be imported in large quantities and used in Pakistan on cotton and other commercial crops.

All USAID projects, including the new 2011 to 2015 Strengthening Agriculture Value Chains (AVC) Project have or will have an IEE written to cover their activities. The AVC Project IEE specifically references the production of this PERSUAP which it planned to be able to cover any and all AVC activities that may involve pesticides. Additional IEEs for agriculture, water and sanitation, avian influenza disinfection, construction and perhaps future malaria projects will reference this PERSUAP and follow its recommendations.

## 1.5 INTEGRATED PEST MANAGEMENT—USAID POLICY

In the early 1990s, USAID adopted the philosophy and practice of Integrated Pest Management (IPM) as official policy. IPM is also strongly promoted and required as part of Regulation 216.3. Since the early 2000s, IPM—which includes judicious use of 'safer' pesticides—has been an integral part of GAPs and is increasingly considered to constitute best management practices in agriculture.

A good definition of IPM from UC-Davis[7] follows:

> "Integrated pest management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials [pesticides] are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment."

The strongest selling points for IPM beyond the health and environmental benefits are, that IPM:

- is more effective than using synthetic pesticides in the long run
- is, once-established, self-perpetuating to a degree
- is less damaging to essential soil health and nutrient cycling
- generally requires less capital (but more labor) investment
- can be used preventively to eliminate or minimize the need for "responsive" controls (e.g. applying pesticides after a pest outbreak occurs to an already-damaged area)

IPM can include possible pest management techniques and tools including:

- Soil and water tests, raised-bed production, tunnels, drip-irrigation[8]
- Pest scouting, monitoring, and identification for accurate decision-making
- Cultural methods that promote pest avoidance and a healthy plant that can better tolerate or resist pests. These methods include, but are not limited to, use of resistant varieties, early/late plantings/harvestings, crop rotation, pruning diseased parts, destruction of pest refuge plants near fields and in crop residues, and GAP practices
- Natural pest control by encouraging and protecting (or purchase and release of) parasitoids, predators, and pest diseases
- Mechanical weed or insect pest control using manual, hoe and machine practices
- Chemical practices such as use of judicious, knowledgeable, and safe application of 'natural' (derived from nature; extracted from plants, microbes, and other organisms) or synthetic pesticides

Good soil characteristics are essential to plant health. For most crops, soils need to provide adequate nutrients and moisture and be well drained. A healthy soil will have a greater capacity to moderate the uptake of fertilizers and will allow a more balanced uptake of nutrients, creating a healthy plant that is less attractive to pests and more resistant to pest damage.

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[7] http://www.ipm.ucdavis.edu/IPMPROJECT/about.html

[8] Note that drip irrigation does not re-charge underground aquifers, so water must be used carefully.

# 1.6 INTEGRATED PEST MANAGEMENT IN PAKISTAN

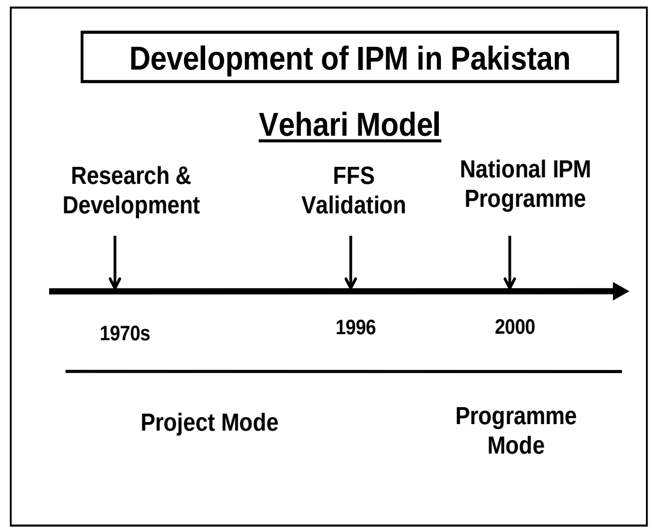
## BACKGROUND

Previously 70-80% of pesticides in Pakistan were used only for the control of insect pests and diseases of cotton while rest on other crops, vegetables and fruits. The trend has now been changed and the extent on cotton had been reduced to 60% (Agri. Statistics of Pakistan 2009-10). Pakistan is one of the leading countries of world where excessive amount of pesticide is used to manage crop pests. Misuse of pesticides played role in disturbing agro ecological system, elimination of natural pest enemies, pest outbreaks, resurgence and resistance in pests, increased pesticide residues in food, contamination of soil and water, direct impact on human health (farmers, applicators, sellers & consumers), extinction of wild life, farmers' profits declining, environment and biodiversity. Pesticide causes poisoning of thousands of people every year where pesticides applicator and women workers are mostly affected. This trend can be arrested by adopting an IPM approach.

The IPM means economic use of available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keeps pesticides and other interventions to cost effective level. Implementation of IPM lies with the farmers, who adopt those elements of IPM which are seen to be practical and add value to their activities.

## FARMER FIELD SCHOOLS (FFS) BASED IPM APPROACH

This approach was originally planned as a way to introduce knowledge on IPM to farmers in Asia. Initially the Philippines and Indonesia were two countries which involved in implementing this extension effort. IPM-FFS experiences of these two countries have since been used to promote and enlarge FFS type activities in other countries of the World. Currently, FFS activities are under implementation in many developing countries, but not necessarily of national scale.




In Pakistan, research and development on IPM was undertaken by Pakistan Agriculture Research Council in 1971. To control Cotton Leaf Curl Virus, a program was initiated in 1995 with the assistance of Asian Development Bank (ADB). In this project, CABI Bioscience Pakistan Centre conducted a pilot study and tested suitability of Training of Trainer (TOT) / FFS approach for IPM implementation in Punjab Province. The key to this IPM strategy was the conservation of natural enemies to reduce or replace reliance on chemical pesticides. This proved that it is quite possible to reduce insecticide applications at least 50% from 6 to 2 sprays per season under IPM decision-making, whilst obtaining the same or slightly higher yields and about 20% higher economic returns to the IPM Farmers. One crop season long ToT and 10 FFSs were conducted in district of Vehari of Punjab province, during 1996 which became famous by the name of "*Vehari Model*". The pilot project adequately demonstrated the potential of FFS approach for large scale implementation of IPM at farm level in Pakistan.

## ESTABLISHMENT OF NATIONAL IPM PROGRAMME (NAT-IPM) IN PAKISTAN

The IPM activities although started in Pakistan long time ago, but it gained a genuine impetus during the 2000s through governmental support and donors co-operation. The IPM was identified as a key factor in the policy and strategy towards response to increasing misuse of pesticides and their negative impacts on ecosystem for sustainable agricultural development. After due consideration and discussion with potential stakeholders, the Government of Pakistan, Ministry of Food and Agriculture (MINFAL) established a National Integrated Pest Management Programme (Nat-IPM) at National Agricultural Research Centre (NARC) of Pakistan Agricultural Research Council (PARC), Islamabad in December 2000

The National IPM Programme has completed a project entitled "Policy and Strategy on Rational Use of Pesticides in Pakistan". Subsequently, the National IPM Programme with the support of FAO-EU successfully completed a project on cotton IPM in Asia and the FAO-ADB Cotton IPM TA for Pakistan and FAO-AGFUND pilot project on "Pesticide Risk Reduction in Women".

The National IPM Programme also undertook a Public Sector Development Programme funded National Integrated Pest Management Project from 2004 -2010. The project was taken as continuation of IPM-FFS activities with the main objective of large scale and sustainable implementation of IPM in Pakistan, rationalizing the use of pesticides while maintaining production levels and increasing farmer's profit.

## IMPLEMENTATION STRATEGY

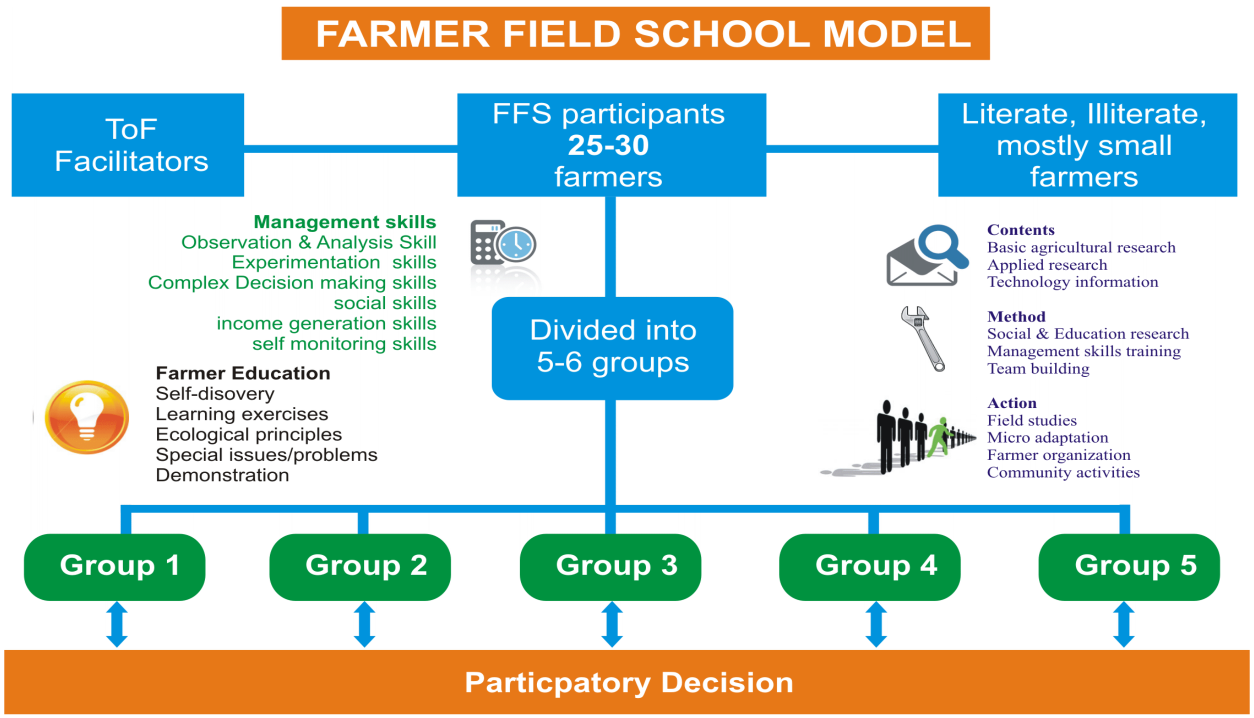
The world experience has shown that the best technique for the translation of knowledge is through Training of Facilitators/Trainers (ToF/T) and FFS activities. Under this approach actions are not pre-planned and are not top down but are based on the analysis of agro-ecosystem and site specific and decisions are made by the beneficiaries with the help of facilitators. The use of ToF and FFS has been verified as an effective and participatory approach and mean of dissemination of IPM in Pakistan.

## TRAINING OF FACILITATORS (TOF)

The purpose of ToF is to develop a team of IPM Trainers/ Facilitators from existing extension departments, research institutions/ organizations, NGO's and FFS trained farmers to train / facilitate farmers in IPM under FFSs. In a ToF, 25 participants are trained over a cropping season. For first two days of each week, the ToF participants observe a selected field and do the Agro Eco System Analysis (AESA), a tool of field observation. Afterward they discuss their observations in the field including the soil and crop health, agronomic requirements, insect pests and their natural enemies etc. This is done throughout the season of the crop. For next two days the ToF participants divided into groups of 5 each to run 10 FFSs and interact with two groups of 25 farmers each in 10 FFSs (with 250 farmers). In this way a team of facilitators develops, which is professionally well good, motivated and fit for proper facilitation of the farmers regarding integrated pest management.

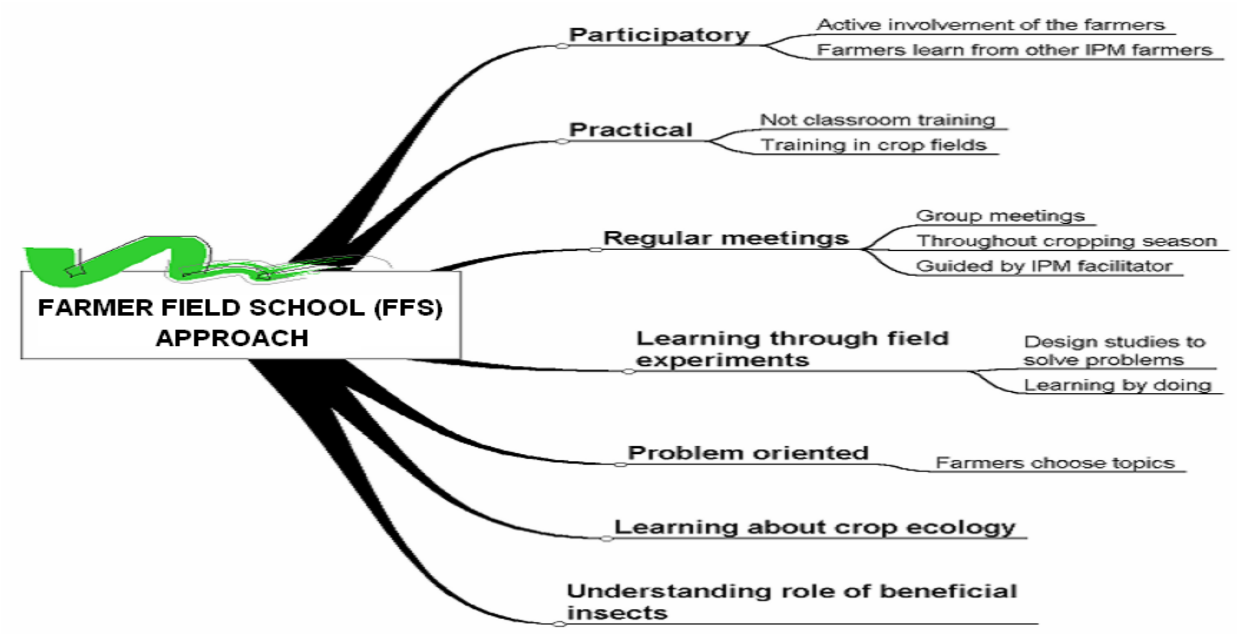
## FARMER FIELD SCHOOL (FFS)

Each FFS contains 25 farmers where participants do the Agro-Eco-System Analysis AESA under direct supervision of trained facilitator. They observe the field, crop growth, pest problems etc. draw their figures and present results on the basis of which further cultural practice and action is decided collectively. If something is not clear, some short & very simple experiments (not too scientific) are set up to resolve the problem. Thus, the farmers become well organized, learn to work in community, become able to make their own day to day decisions and develop expertise to the extent that they can manage crop production issues without external support of chemical companies or extension staff. In this way farmers are introduced with discovery based learning process, which empower the farmers for better utilization of available farm resources. Farmers Field School model and Farmers Field School concept adopted by IPM program Pakistan is given below in diagrammatic format.




*Source: National IPM Programme*

## FFS Concept




*Source: National IPM Programme.*

### FAO-EU IPM PROGRAMME FOR COTTON IN ASIA (2001-2004)

The FAO-EU IPM Project (2001-2004) was executed in six countries (Pakistan, China, Bangladesh, India, Philippines and Vietnam) for rural poverty alleviation and agro-biodiversity protection by following ecosystem-based production and pest management approaches. The focus of the program was to develop training capacity and to educate cotton farmers about the agro-ecosystem and to verify and further develop environment friendly pest control strategies. The skills training took place in weekly, season-long practical sessions called FFS. Under this project a total of 425 IPM facilitators from existing extension departments, research institutions/ organizations, NGO's and Farmer Organizations were trained in 12 ToF courses. A total of 525 crop season long FFS were organized in provinces of Punjab, Sindh and Balochistan. The total number of beneficiaries was 12,999 farmers.

To encourage women's participation, AGFUND initiated a project on "Pesticide Risk Reduction for Women in Pakistan". It focused on training of female facilitators to reach rural women in the traditional, gender-segregated society through Women Open Schools. The emphasis was given on the toxicity and health risks of pesticides among others. Under this project, 1,000 women farm workers were trained through 19 Women Open Schools (WOS) in Sindh and Punjab province.

## GOVERNMENT FUNDED NATIONAL IPM PROJECT (2004-10)

As a Follow-up of FAO-EU IPM Programme for Cotton in Asia, the Government of Pakistan launched a PSDP-funded Project: "National Integrated Pest management" (2004-10). This project was executed by National IPM Programme PARC with the collaboration of Provincial Agricultural Departments and IPM Farmer Organizations. Project activities were implemented in all four provinces. The primary objective of was the capacity building of farmers through establishment of IPM based ToF and FFSs education approach to manage fruit, vegetables, rice and cotton crops. FFS approaches promoted IPM through enhancing farmer's understanding of the ecological principles behind the safe and effective management of harmful insect pests and disease causing pathogens. During project life span a total of 532 IPM facilitators were trained in 19 IPM crop season long ToF courses held in 19 districts. It also conducted 1872 crop season long FFS in Punjab, Sindh, Khyber Pakhtunkhawah, Balochistan and Gilgit. The total number of beneficiaries was 45557 farmers.

## STATUS OF CAPACITY BUILT IN IPM-FFS APPROACH

The National IPM Programme NARC Islamabad is mandated to provide technical backstopping and support to all federal, provincial institutions, NGO's and farmer organizations involved in the implementation of IPM through FFS education approach throughout the country. As a result of several activities undertaken during past several years a team of 2,770 trained facilitators has been developed through 107 ToF and 6,664 FFS, WOS and Children's Ecological Clubs (CEC). Hence a total of 141,700 Farmers including women & Children imparted crop season long FFS training on different crops throughout Pakistan. The program with the support of Government of Pakistan, FAO of United Nations, ICARDA and other National and International donors has also initiated FFS and conducted enormous experiments on Kitchen Gardening, Integrated Livestock Management, Wheat management with respect to Rust diseases, Food preservation and integrated Management for Bee keeping. At Present to educate the farmers in any field of agriculture and livestock the inclusion of FFS education approach is a routine practice by the private and public sector at national level. Specific dates are given below. The work done by some FFS implementing organizations is not updated. Hence it is anticipated that the number of FFS trained Farmers would be more than 0.2 million.

### TABLE: STATUS OF CAPACITY BUILDING

| Gender | ToF/ToF | Facilitators Trained | FFS/WOS/CEC | Farmers Trained |
|---|---|---|---|---|
| Female | 10 | 302 | 954 | 24330 |
| Male | 97 | 2,468 | 5,710 | 117370 |
| **Total*** | **107** | **2,770** | **6,664** | **141,700** |

*Source: National IPM Programme*

### TABLE: CROP/ COMMODITY WISE TRAINING OF FARMERS UNDER IPM BASED FFS APPROACH

| Crop | FFS | Farmers Trained |
|---|---|---|
| Cotton | 3903 | 74056 |
| Wheat | 58 | 1357 |
| Vegetables | 1328 | 32602 |
| Date Palm | 196 | 4534 |
| Mango | 564 | 13724 |
| Citrus | 238 | 5950 |
| Apple | 73 | 1615 |
| Sugarcane | 11 | 220 |
| Rice | 182 | 5487 |
| Live-Stock | 39 | 135 |
| Maize | 50 | 1,250 |
| Bee Keeping | 9 | 315 |
| Food Preservation | 13 | 455 |
| **Total** | **6,664** | **141,700** |

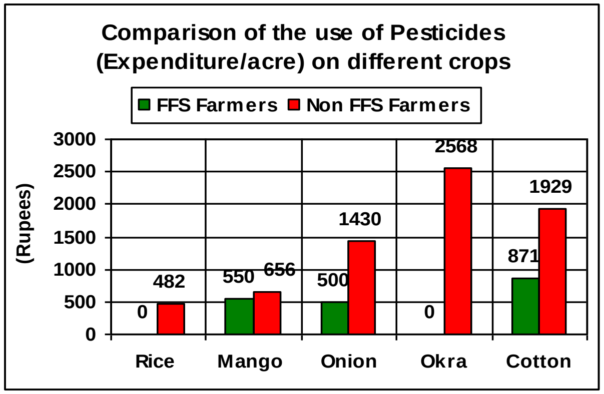
*Source: National IPM Programme*

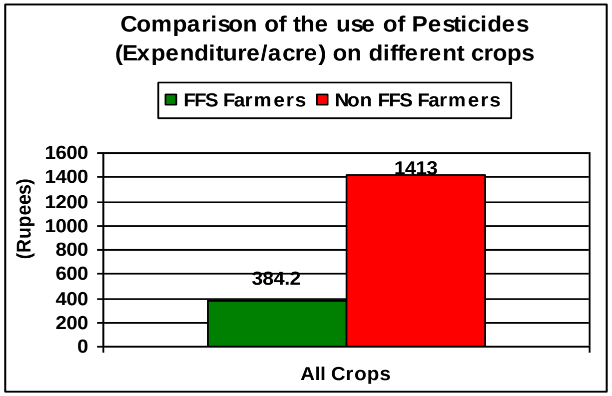
### TABLE: PUBLIC AND PRIVATE SECTOR INVOLVED IN CAPACITY BUILDING OF FARMERS & FACILITATORS IN IPM-FFS APPROACH

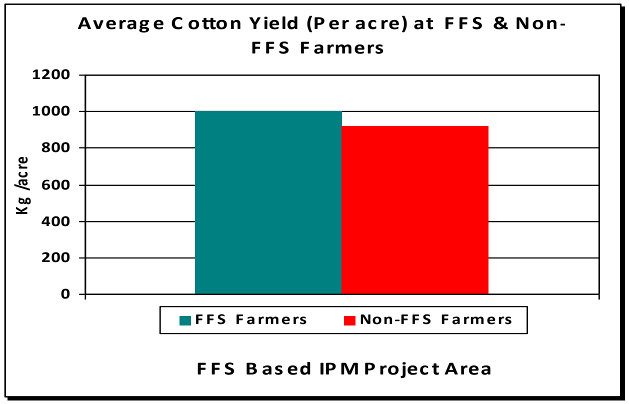
| Institute/Organization | ToF/WToF/ FToF | Facilitators Trained | FFS/WOS/ CEC | Farmers Trained |
|---|---|---|---|---|
| Nat-IPM-FAO-EU | 17 | 479 | 525 | 12999 |
| Nat -IPM-AG, Fund | 3 | 78 | 61 | 977 |
| Nat-IPM Project | 19 | 532 | 1872 | 45557 |
| Plan-Pak, Vehari | 3 | 74 | 96 | 2087 |
| KWA-WWF-Pak | | | 99 | 2114 |
| WWF-Pakistan | 6 | 150 | 201 | 4509 |
| KWA-FAO-Kashmir & Bwp. | 1 | 32 | 86 | 2330 |
| KWA-UNICEF | | | 20 | 1400 |
| Lead-Pakistan, Sindh | | | 14 | 260 |
| CCRI-Sindh (MINFAL) | | | 12 | 300 |
| CARITAS-Sindh | | | 12 | 300 |
| Dev-Con-UNDP | | | 8 | 200 |
| PRSP-Khanewal | 5 | 141 | 475 | 10498 |
| Agri. Extension, Punjab | 32 | 800 | 2074 | 28818 |
| Agri. Extension, Sindh | 1 | 25 | 25 | 625 |
| Agri. Extension, Balochistan | 2 | 44 | 80 | 2000 |
| Agri. Extension, Khyber Pakhtoonkhawah | | | 128 | 3200 |
| Agri. Extension, Gilgit, Baltistan | | | 40 | 1000 |
| OFWM, Sindh | 6 | 158 | 335 | 9881 |
| Agri. Extension-Punjab-Fruit & Veg | 2 | 50 | 200 | 5000 |
| Society of Facilitators and Trainers | 10 | 207 | 291 | 7495 |
| WADO-Sindh | | | 10 | 150 |
| **Grand Total** | **107** | **2770** | **6664** | **141700** |

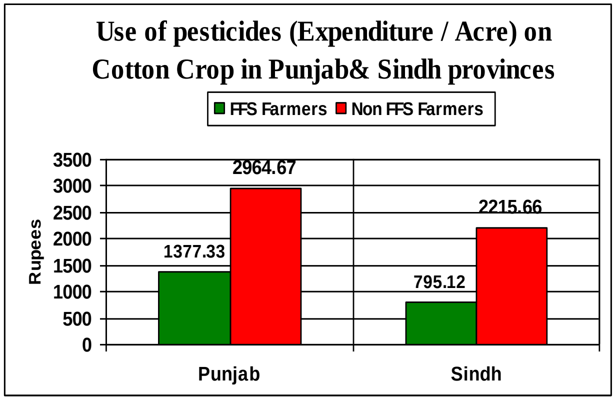
Source: National IPM Programme

With regard to quantitative outcomes, the IPM programs in Pakistan have been able to: develop a trained cadre for agriculture information dissemination, sensitize community regarding pesticides and its impact on ecosystem and involve women in activities. The impact of the IPM program is not conclusive as no impact assessment evaluation has been carried out by any independent third party. However an IPM impact assessment study carried out itself by National IPM Programme showed that FFS Farmers have reduced average pesticide use in all crops (under study) by 72.81% as compared to the non FFS farmers while in Cotton crop, FFS Farmers have reduced pesticide use by 58.06%. They have achieved 10.5% more cotton yield / acre and achieved more Net profit by 25.54%.  FFS Farmers have reduced input cost by 73% expenditure on Pesticides, 11% on Fertilizers, 39% saving on Irrigation expenses. Some of the data generated by this study is expressed graphically are given below.



## ESTABLISHMENT OF FACILITATOR'S & FARMER'S COMMUNITY ORGANIZATIONS

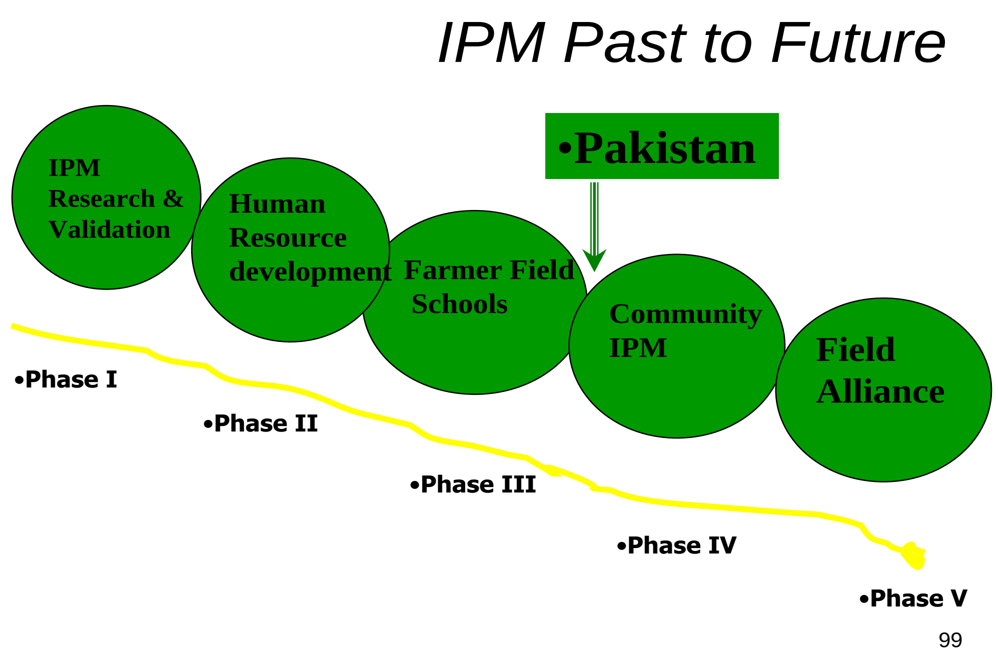
For continuity and refreshment of knowledge and skills of the facilitators/farmers, annual facilitation skills enhancement workshops, farmers' congresses, workshops on community and leadership management were organized. As a result of this process various associations/organizations of IPM farmer facilitators and women facilitators have emerged and working sustainably by generating their own resources/with support of public & private sector and NGO's. The women trained through, Women Facilitators Training (WFT) approach has established their organizations independently or under the joint venture with male farmer facilitators in their respective areas. They have up-scaled themselves by making several innovations. Women organizations are working with NGOs, public and private, national and international organizations. They have completed various development projects where they have worked for the capacity building of rural women in different fields of livelihood such as poultry & livestock management, literacy, stitching, embroidery, kitchen gardening, health measures and micro credit schemes. A total of 28 organizations have been developed or registered under this program. The detail is given below.

### TABLE: LIST OF IPM FACILITATOR'S & FARMER'S COMMUNITY ORGANIZATIONS (REGISTERED) DEVELOPED UNDER IPM BASED FFS PROCESS

| Community Organization | |
|---|---|
| KWA | Kissan Welfare Association, Bahawalpur |
| KWA | Kissan Welfare Association, Muzafar Abad, AJK |
| KF | Kissan Foundation, Rahim Yar Khan |
| KF | Kissan Foundation, Multan |
| KF | Kissan Foundation, Muzafargarh |
| KF | Kissan Foundation, Gujranwala |
| KF | Kissan Foundation, Sargodha |
| FIDA | Farmer Integrated Development Association, Vehari |
| KDA | Kissan Dost Association, Khanewal |
| KDO | Kissan Dost Organization, Bahawalpur |
| SAO | Sustainable Agriculture Organization, Khairpur |
| WADO | Women Agriculture Development Organization, Khairpur |
| WADO | Women Agriculture development Organization, Balakot, |
| FFO | Farmer Facilitator Organizations, Khairpur |
| IDF | Indus Development Foundation, Khairpur |

| Community Organization | |
|---|---|
| SAFE | Sustainable Agriculture & Friendly Environment, Shaheed Benaziarabad |
| RADO | Regional Agriculture Development Organization, Noshero Feroze |
| NAFO | Natural Agriculture Farming Organization, Sanghar |
| FAIDO | Farmer Agriculture Innovative Development Organization, Mirpurkhas |
| SADA | Sindh Agriculture Development Association, Mithi |
| IFWA | Indus Farmer Welfare Association, Ghotki |
| GALA | Ghotki Agricultural & Loyal Association, Ghotki |
| MAWA | Moan Jo Daro Agriculture Welfare Association, Larkana, |
| SAFWO | Sustainable Agriculture Farmer Welfare Organization, Sukkur |
| RDSA | Rural Development Support Association, Bala Kot |
| SOFT | Pakistan- Society of Facilitators and Trainers, Islamabad |
| LIFE | Linkages Initiatives for Farmers Educations, Gilgit |
| WAFA | Women Agriculture and welfare Association, Bahawalpur |

*Source: National IPM Programme*




Source: National IPM Programme.

## BIOLOGICAL PLANT PROTECTION MEASURES IN PAKISTAN

There has been a severe competition for food between human societies and pest populations. Cumulative loss due to insect pests has been enormous running in to trillion of rupees. With the advent of synthetic pesticides the pest control has mostly been achieved through these chemicals. The greater reliance on chemical control was placed due to its mass appeal. To reduce reliance on chemical control, concept of IPM emerged. At national level unfortunately Pakistan has pesticides based IPM so biological plant protection measures are very weak.

Biological control has an important role to play in modern IPM but can never provide a complete solution to pest problems. Among the benefits of biological control, one important is that there is no harmful effect on other beneficial organisms or hazards to humans or wildlife. Also, pests do not become resistant to natural enemies in the way that they do to insecticides. Biological control once established is largely self-sustaining as natural enemies tend to respond to increases in the populations of their hosts. For these reasons renewed impetus has been given to biological control in recent years, particularly as a component of management systems.

Work on biological control of insect pests has been started since inception of Pakistan. Scattered investigations were going on in different research and teaching institutions of the country. However detail research was started with the establishment of Commonwealth Institute of Biological Control (CIBC) at Rawalpindi in 1956. Since then, comprehensive basic work has been done. So far the knowledge mass on biological control consists of 750 numbers of insects whose natural enemies have been made known while 700 natural enemies were recorded by PARC.

In Pakistan practical biological control has been exploited mainly on sugarcane insect pests with tremendous success. Several sugar mills now independently run their own program in Pakistan. Millions of rupees have been saved through augmentation and conservation on natural enemies of sugarcane insect pests. Additionally benefits have been achieved in the shape of lesser pollution in the environment. Horticultural crops are another area where biological control measures can be exploited. Some of successful efforts have been made to tackle scales and mealy bugs by natural enemies which cause enormous damage. Recent example to quote is success in biological control of mealy bug in cotton in Pakistan achieved under the federal government sponsored project "biological control of major cotton pests including mealy bug". Having major breakthrough in biological control of mealy bug the programs on biological control of other pests including whitefly, jassids, and armyworm bollworms have been initiated on pilot area of 500 acres area each at Bahawalpur and Mir Pur Khas.

Other classical examples are biological control of woolly aphid on apple, through successful introduction of a parasitoid *Aphelinus mali* from Switzerland in 1984, *Cotesia flavipes* against borers in sugarcane and maize in 1961, *Telenomus remus* and *Euplectrus platyhypanae* from Bardbados in 1980, 1981 against armyworm; *Bracon kirkpatricki* and *Chelonus blackburni* against cotton bollworm in 1981; *Prospaltella perniciosi* in 1959 against San Jose scale on apple, *Leptmastix dactylopi* from Texas against grape mealy bug in Quetta valley in 1982. Besides these about 25 beneficial species were imported from different countries at different times and released in Pakistan. However, their status if they are established in Pakistan is not clear. Biological control programs for fruit flies have also been initiated by CABI Pakistan.

Although large number of farmers have been sensitized in biological control approaches but the whole approach has not attained high momentum. One of the reasons has been non availability of modern system of mass rearing of natural enemies. No private company is involved in biological control measures business. Availability of trained human resource is another problematic area which is not presently available. There is no specialized institute in Pakistan on this topic. The work is mostly scattered that need to be coordinated to expand this activity both for knowledge enrichment and applied purpose.

## BIOPESTICIDES STATUS IN PAKISTAN

Exploitation of plant based and microbe based bio pesticide is under consideration in Pakistan since long. PARC had undertaken study on various plant materials to find effectiveness but only able to develop Neem (Azodirachta indica) based bio control agent as commercial products i.e. *Nimbokill* and *Nimboli*. The *Nimbolill* was prepared for use against crop insect pests while *Nimboli* was against house insects such as mosquito. These products were marketed but could not get popularity. For weed management, University of Agriculture, Faisalabad has been involved for the last twenty years to develop plant water extract based herbicide and has found some success in managing weeds. But however no product was commercialized up till now. With regard to microbial based bio pesticides, several products are registered and have good market potential in Pakistan. Products as biopesticides or biological like Abamectin, Bacillus Thuringiensis, Emamectin Benzoate, Azadirachtrin, Gossyplure, Heliothis armigera NPV WG,  Oxymatrine+Prosuler , Pectinophora Gossypiella,  Spinetoram, Spinosad, and  Trialkoxydim are in use as commercial products in Pakistan.

### IMPACT OF PESTICIDES ON AGRO-BIODIVERSITY IN PAKISTAN

Because of extensive use of pesticides in the country the natural control of pests has severely suffered and crop production system has reached a stage where no crop is possible without pesticides. Pests resurgences have become a common phenomenon resultantly pesticides sprays have to be made repeatedly. In 1960s, three bollworms species and a bug were the major pests of cotton.  Contrarily Pakistan now has extended list of pests in cotton that include 11 major pests.  Secondary pests have now become the major pests in crops. Some of the pests such as fruit flies, army worms, thrips, jassids, whiteflies and mealy bugs have become difficult to control by routine pesticides spraying so alternate measures are needed that strengthen the natural control of pests.

As such there is not much documented evidence of decline in biodiversity at national level; however, decline in natural control of pests in some cases reported by CABI Central and West Asia (CWA) gives reflection of the existing situation of impact of pesticides on agro-biodiversity. Above 50% parasitism was reported in fruit flies in 1970s that went even below 3% in 2003-05 (CABI Final Report 1968-72 and CABI Final report 2002-2006).

The scarcity of the natural enemy fauna in Pakistan agro-ecosystem was experienced severely in 2005-06 when mealy bug accidently entered Pakistan and because of weak endemic natural enemy fauna it increased to high proportions. Two predators namely *Chrysopa* sp and *Coccinella septempunctata* were found attacking the mealy bug in small numbers in 2005-06.  With conservation practices started in 2007-08 in Punjab, Sindh and Balochistan under MINFA sponsored project 13 species of predators and a parasitoid had the chance to shift to this alien species and largely contributed in bringing down mealy bug populations. (CABI Annual Reports 2007-08 and 2008-09). Because of slowing down of conservation practices from 2010 and increased pace of pesticides use the mealy bug has once again started increasing in 2011 (2010-2011 reports of the Department of Pest Warning and Pesticides Quality control Government of Punjab).  Other important negative effects of pesticides overuse are the loss of honey bees, crop pollinators, soil dwelling insect predators and other useful fauna.

## 1.7 PAKISTAN PERSUAP METHODOLOGY

During planning for this study, a decision was made to use one local Pakistani Consultant (PC) and one International Consultant (IC), who would both collect and analyze information from Pakistan’s pesticide sectors.  The largest tasks would be the analysis, for Regulation 216 compliance, of the active ingredients in each pesticide registered by Pakistan for import and use as well as the analysis of primary pests in each sector and of each crop or livestock, so that preventive IPM plans could be made.

During August and September 2011, the IC collected information from numerous web sources, including Pakistan agriculture, warehouse treatments, livestock treatment, malaria treatment, pests, IPM/IVM, pesticide risks, and mitigation of those risks.  In August, the PC visited Pakistani government officials, pesticide distributors and shops, demonstration farms, other agriculture projects throughout Pakistan.  Information was collected on seed treatments, field crops, greenhouse crops, and during September, additional information was collected on issues with pesticides treatments for livestock, mosquitoes, bird flu, water, and construction. The findings are presented in this PERSUAP report.

The strategy used for writing this PERSUAP is for it to contain as many links to websites with best practices as possible, both to make it easier to use (reduce the length and thickness) and more up-to-date or accurate (as websites are updated). So, instead of having numerous Annexes containing pesticide safety equipment recommendations or safe pesticide use practices, websites now take their place.

# SECTION 2: BACKGROUND

## 2.1 PAKISTAN COUNTRY BACKGROUND

Pakistan is a Southern Asian country of about 779,000 square kilometers, and almost 165 million people, bordering the Arabian Sea, sandwiched between India on the east, China on the north and Iran and Afghanistan on the west. See Map (Figure 1) below of Pakistan and its neighbors.


Pakistan is composed of flat Indus plains in east; mountains in north and along the northwest border with Afghanistan; the Balochistan plateau in west, and with the Indus River flowing directly through the middle of the country from north to south. The climate is mostly hot, dry desert; temperate in northwest; arctic in mountainous north.

The Indus Valley civilization, one of the oldest in the world and dating back at least 5,000 years, spread over much of what is presently Pakistan. During the second millennium B.C., remnants of this culture fused with the migrating Indo-Aryan peoples. The area underwent successive invasions in subsequent centuries from the Persians, Greeks, Scythians, Arabs (who brought Islam), Afghans, and Turks.

### INTERNATIONAL TRADE

Pakistan trade includes: *Exports*--$14.85 billion: textiles (garments, bed linen, cotton cloth, and yarn), rice, leather goods, sports goods, carpets, rugs, chemicals & manufactures. *Major partners*--U.S. 22.6%, United Arab Emirates 8.9%, U.K. 5.8%, China 5.4%, Germany 4.7%. *Imports*--$21.26 billion: petroleum, petroleum products, machinery, plastics, paper and paper board, transportation equipment, edible oils, pulses, iron and steel, tea. *Major partners*--China 14.0%, Saudi Arabia 10.5%, United Arab Emirates 9.0%, Japan 6.2%, U.S. 5.1%, Kuwait 5.1%, Germany 4.9%. Pakistan exports textiles (garments, bed linen, cotton cloth, and yarn), rice, leather goods, sports goods, chemicals, manufactures, carpets and rugs. Major export partners as of 2005 are US 24.8%, UAE 7.8%, Afghanistan 6.6%, UK 5.7%, Germany 4.5%.

## FISCAL POLICY

International Monetary Fund (IMF)-approved government policies, bolstered by generous foreign assistance and renewed access to global markets since 2001, have generated solid macroeconomic recovery the last five years. The government has made substantial macroeconomic reforms since 2000, most notably privatizing the banking sector. Poverty levels have decreased by 10% since 2001, and Islamabad has steadily raised development spending in recent years, including a 52% real increase in the budget allocation for development in FY07, a necessary step toward reversing the broad underdevelopment of its social sector.

The fiscal deficit - the result of chronically low tax collection and increased spending, including reconstruction costs from the October 2005 earthquake - appears manageable for now. GDP growth, spurred by gains in the industrial and service sectors, remained in the 6-8% range in 2004-06. Inflation remains the biggest threat to the economy, jumping to more than 9% in 2005 before easing to 7.9% in 2006. The central bank is pursuing tighter monetary policy - raising interest rates in 2006 - while trying to preserve growth. Foreign exchange reserves are bolstered by steady worker remittances, but a growing current account deficit - driven by a widening trade gap as import growth outstrips export expansion - could draw down reserves and dampen GDP growth in the medium term. Now, in 2011, the GOP is faced with a deteriorating economy as foreign exchange reserves decline, the currency depreciates, and the current account deficit widens.

## AGRICULTURE AND NATURAL RESOURCES

Agriculture in Pakistan dates back to Neolithic times. It formed the base of the well-known Indus Valley Civilization. Of late, its contribution to the Gross Domestic Product (GDP) has decreased from 52% in 1950-51 to just 24% in 1993-94, and lower in the 2000s. This is primarily because of higher growth rates registered by other sectors, particularly, the Manufacturing and Mining.

Pakistan is a land of subsistence agriculture. The main emphasis is on the production of food crops that account for about 70% of the cropped area. Some cash crops (cotton, sugarcane, tobacco, for instance) are grown to meet other needs. About 23% of the total land area is cultivated. Still, the cropped area has increased from 14.6 million hectares in 1947-48 to about 22.15 million hectares in 1993-94: a hefty increase of about 52%.

Pakistan's principal natural resources are arable land, water, hydroelectric potential, and natural gas reserves. About 28% of Pakistan's total land area is under cultivation and is watered by one of the largest irrigation systems in the world. Agriculture accounts for about 21% of GDP and employs about 42% of the labor force. The most important crops are cotton, wheat, rice, sugarcane, fruits, and vegetables, which together account for more than 75% of the value of total crop output. Despite intensive farming practices, Pakistan remains a net food importer. Pakistan exports rice, fish, fruits, and vegetables and imports vegetable oil, wheat, cotton (net importer), pulses, and consumer foods.

The economic importance of agriculture has declined since independence, when its share of GDP was around 53%. Following the poor harvest of 1993, the government introduced agriculture assistance policies, including increased support prices for many agricultural commodities and expanded availability of agricultural credit. From 1993 to 1997, real growth in the agricultural sector averaged 5.7% but declined to less than 3% in 2005. Agricultural reforms, including increased wheat and oilseed production, play a central role in the government's economic reform package.

Heavy rains in 2005 provided the benefit of larger than average cotton, wheat, and rice crops, but also caused damage due to flooding and avalanches.  Since then crop yields have fluctuated annually.

Pakistan has extensive energy resources, including fairly sizable natural gas reserves, some proven oil reserves, coal, and large hydropower potential. However, exploitation of energy resources has been slow due to a shortage of capital and domestic and international political constraints. For instance, domestic gas and petroleum production totals only about half the country's energy needs, and dependence on imported oil contributes to Pakistan's persistent trade deficits and shortage of foreign exchange. The government announced that privatization in the oil and gas sector is a priority."

## 2.2 DONOR-SUPPORTED AGRICULTURE AND SECTORS WITH POTENTIAL PESTICIDE USE IN PAKISTAN

In addition to the above-mentioned (Sections 1.4 and 1.6) USAID and donor-funded initiatives in agriculture and IPM, namely I-LED, FATA-LDP, British CABI Bioscience Pakistan Centre, FAO FFS, ADB TOT and Training of Facilitators (TOF), National IPM Programme, FAO-ADB Cotton IPM, FAO-AGFUND pilot project, FAO-EU IPM Project, CIBC, other relevant projects include the following.

### USAID

2011-2015 Strengthening Agriculture Value Chains (AVC)

This project will help farmers adopt improved technologies and practices, and access financing.  The goal is to increase productivity and incomes; improve efficiencies in the value chains (farms to markets) in selected subsectors; improve the quality as well as expand domestic production of livestock, dairy, fruits and vegetables and increase the capacity for domestic producers to profitably service local and export markets.  Livestock, dairy and horticulture were chosen because of their potential benefit to smallholder farmers and, in particular, women.  Increasing adoption of crop and livestock technologies inevitably means that pesticides will be essential inputs, and proper selection and use will need to follow recommendations found in this PERSUAP.

2011-2013 Gomal and Satpara Dams Projects

These projects support the completion of construction of dams.  When large construction projects such as dams are implemented, borrow pits are inevitably formed as soil is moved from one place to another.  Left unguarded and without proper signage, they become drowning traps for children.  But more than this, much more than this, left untreated, they become breeding waters for malarial mosquitoes.  Also, shallow weedy parts of the dammed-up water can breed mosquitoes.  These bodies of water will need to be managed and may require preventive treatment with biological insecticides.

2011-2014 Dairy Project

The goal of this dairy and livestock development project is to increase dairy farmers' incomes by 25 percent by improving animal husbandry, increasing milk yields, and establishing linkages to higher value markets. USAID, as part of a three-year public-private partnership, will increase rural incomes, especially for women, by improving the marketing, as well as the quantity and quality of milk production for over 16,000 smallholder farmers. Livestock will inevitably need to be treated with acaricides to control disease-transmitting ticks and rearing areas with insecticides to control disease-carrying and biting flies.

2009-2011 Balochistan Agriculture Project

This project supports the UN Food and Agriculture Organization's efforts in the Balochistan border areas to build the capacity of men and women within 100 miles of the Afghan border to benefit from increased crop and livestock production. The objective of the project is to increase incomes of 10,000 households by 20% in five districts over three years, through the adoption of improved technology, marketing and producer organizations, research on improved farming techniques, and establishing linkages between farmers and government services. Women are of particular focus through the creation of women's community organizations. Increasing incomes from crops and livestock inevitably means that pesticides will be essential inputs, and proper selection and use will need to follow recommendations found in this PERSUAP.

2011-2012 Grain Storage Project

This project provides world-class technical expertise to support the establishment of public-private partnerships for the management, handling, and storage of strategic grain reserves for the Governments of Punjab and Sindh. This includes drafting technical and legal feasibility studies that will result in the bidding and evaluation procedures for an expected private sector investment of over $200 million in the sector. Grain storage absolutely requires treatment with insecticides, rodenticides and occasionally microbicides. Many of the chemicals currently used, including banned fumigant methyl-bromide and restricted fumigant aluminum phosphide, are highly toxic to humans. Mistakes can turn deadly. Recommendations found in this PERSUAP will need to be followed.

2008-2012 FATA Livelihoods Program

This project works in three key areas: agriculture, workforce development opportunities, especially for youth, and microenterprise in order to improve economic and social conditions necessary to lay a foundation for longer term stability and development in the FATA. Increasing agricultural output inevitably means that pesticides will be essential inputs, and proper selection and use will need to follow recommendations found in this PERSUAP.

2009-2014 FATA Infrastructure Program

This project supports the rehabilitation and reconstruction of roads, restoration of damaged electricity infrastructure and electrification of villages for improved electricity services, and improvements in access to water for human consumption and agricultural irrigation in the FATA.

2009-2015 Khyber Pakhtunkhwa Reconstruction Program

This program represents the first tranche of USAID's support to the reconstruction and recovery of conflict-affected districts of Khyber Pakhtunkhwa (KP). It builds upon previous and ongoing humanitarian relief efforts, by supporting priorities identified and quantified in the "Damage Needs Assessment", and contributing to the Government of Pakistan's "Comprehensive Stabilization and Socio-Economic Development Strategy". Under this program, USAID supports the Government of KP is in the areas of education, health, and water and sanitation.

2010-2011 Malakand and FATA Housing Support Program

This project provides contributions to a 2009 Government of Pakistan housing assistance program for rebuilding or repairing homes damaged or destroyed in the military actions to dislodge extremists from Pakistan's border areas with Afghanistan. USAID's contribution will help to benefit approximately 23,000 households.

2010-2013 Jacobabad /Peshawar Water Program

This project will design two new water, sanitation, and hygiene activities that will complement the Government of Pakistan's work to reduce the incidence of diarrheal and other water-borne diseases in Northern Sindh and the KP by improving water and sanitation infrastructure, increasing community awareness, and changing household behaviors related to water and hygiene.

2009-2011 Karachi Warehouse Project

This project supports the construction of a warehouse to store contraceptive commodities creating a central place for distribution throughout the country.

2010-2011 Construction of Pakistan Institute of Parliamentary Services Building

This project supports construction of a building for the Pakistan Institute for Parliamentary Services (PIPS). PIPS was created by the National Parliament in December 2008. The Institute was first proposed by national and provincial parliamentarians in 2005. The Institute's mandate is to: conduct professional development and orientation programs for elected parliamentarians and the staff of the national parliament and provincial assemblies; assist parliamentarians to be more informed by conducting or commissioning independent research on topical issues; gather and organize data, which may be required by the parliamentarians in their work; and provide support services to members. The Institute also provides in-depth research, analysis, information databases and briefings for members and staff to increase their understanding of public policy issues and legislative initiatives. A prime goal of the Institute is to provide non-partisan and expert opinion on a wide-range of subjects, and to help the legislatures in making informed policies to address national challenges. The structure will house offices, seminar rooms, a library and auditorium equipped and furnished to fulfill the needs of the institute.

As all of these construction projects are implemented, borrow pits will inevitably be formed as soil is moved from one place to another. Left unguarded and without proper signage, they can become drowning traps for children. In fact, a child drowned in an unguarded water-filled borrow pit at a USAID-supported construction site in southern Sudan in 2010. But more than this, left untreated, they become breeding waters for malarial mosquitoes. These bodies of water will need to be managed and may require preventive treatment with biological insecticides.

### UNFAO

From 2006 to 2011, in addition to the above-mentioned IPM projects, FAO has with multiple donors' funds supported agriculture projects in earthquake-, flood- and cyclone-damaged regions, and in 2006 Avian Influenza activities. In addition, the following relevant projects and activities have been carried out, many with US funds, some EU funds and some IFAD funds.

2010-2011 OSRO/PAK/011/USA: Emergency livelihood assistance to support flood-affected vulnerable farmers in Punjab, Pakistan. Immediate inputs assistance to restore the agriculture and livestock based livelihoods of 242,250 vulnerable farming households in flood-affected districts of Punjab, Pakistan.

2010-2011 OSRO/PAK/016/AUL: Emergency assistance to support flood-affected vulnerable farmers in Sindh Province of Pakistan. To provide immediate assistance for the restoration of the agriculture based livelihoods of 18 700 vulnerable farming households in the flood-affected Khairpur, Kashmor, Shikarpur, Nawabshah, Jacobabad, Larkana and Thatta Districts of Sindh Province of Pakistan

2011 OSRO/PAK/015/IFAD: Post-Flood Assistance for the Recovery of Production & Livelihoods of Smallholder Farmers in Pakistan - (Grant No. I-R-1236-FAO). Provide critical agriculture inputs (rice and vegetable seed with appropriate fertilizers) to 4,100 vulnerable households in order to protect and restore their agriculture-based livelihoods

2010-2011 OSRO/PAK/014/USA: Emergency livelihood assistance to support flood-affected vulnerable farmers in Balochistan - Grant No. AID-OFDA-G-10-00159-02. Immediate resumption of the agricultural production cycle through the provision of wheat seeds, vegetable seeds and fertilizers; De-silting/cleaning of critical on-farm irrigation infrastructure for Rabi 2010 planting season through Cash For Work programmes; Protection and restoration of livestock productivity through the provision of livestock input supplies and sorghum seeds for the restoration of short and medium term green fodder availability; Provision of training for improved production.

2010-2011 OSRO/PAK/010/USA: Emergency assistance to support flood-affected vulnerable farmers in Pakistan. Distribution of wheat seeds and fertilizers for the Rabi 2010 planting season; Immediate resumption of the agricultural production cycle to underpin food security through provision of vegetable seeds especially for female farmers; De-silting of critical farm irrigation infrastructure in time for the Rabi 2010 planting season, through Cash For Work programmes; Protection and restoration of livestock productivity through the provision of livestock input supplies; Provision of training for improved production.

2010-2015 GCP/PAK/123/USA: Support to Increase Sustainable Livestock Production. Support to Increase Sustainable Livestock Production

2009-2013 OSRO/RAS/901/EC: Improvement of regional capacities for the prevention, control and eradication of highly pathogenic and emerging diseases (HPED) including Highly Pathogenic Avian Influenza (HPAI) in ASEAN and SARCC countries: Regional Project - 18 participating countries including Pakistan. To strengthen and empower ASEAN and SAARC, in their ability to prevent, control and eradicate HPED, including HPAI, through improved veterinary and public health services and inter-sectoral collaboration on a regional basis

### UNWFP

August 2010 – December 2011: Emergency Operation: Emergency Food Assistance to Families Affected by Monsoon Floods in Pakistan

Due to the 2010 and 2011 monsoon flooding, WFP has provided life saving food assistance to more than 1.3 million people in the Sindh and Balochistan and is reaching over 50,000 new people each day[9]. WFP is preparing to scale up to provide food for 2.5 million people over the

[9] http://www.wfp.org/countries/pakistan

coming four months. An initial assessment in Sindh and Balochistan shows that as many as 5.8 million people have been affected. The WFP nutrition toolbox already includes fortified staples, fortified condiments and fortified blended foods. Among the fortified blended foods is corn soya blend (CSB), which WFP has used for decades.

January 2011 – December 2012: Protracted Relief and Recovery Operation: Food Assistance for Household Food Security, Early Recovery, Peace and Social Stability

Worsening food security has been most pronounced in marginalized areas along Pakistan's western border which have been subject to conflict and mass displacement in recent years. Targeting up to 9.5 million beneficiaries during 2011 and 2012, this operation draws upon the full range of tools in WFP's arsenal, in order to best respond to immediate food needs, support recovery from multiple shocks and contribute to social cohesion. These include the provision of emergency relief rations to conflict-affected groups who remain displaced or have recently returned home in KPK and FATA; school feeding to promote access to education; nutritional support measures for children and women; livelihood recovery activities through community-based employment using food and/or cash; and measures aimed at developing institutional and local capacities in disaster risk management.

## UNDP

The United Nations Development Programme (UNDP) is an important partner of the Government of Pakistan for achieving national development goals and international commitments including the Millennium Development Goals (MDGs). UNDP's works with the Government, civil society and development partners in four broad programmatic areas; Poverty Reduction and Gender, Democratic Governance, Environment and Climate Change and Crisis Prevention and Recovery.

July 2006-Dec 2011: Community Based Area Development Programmes: Area Development Programme Balochistan (ADP-B II)

The ADPB is a community-based area development programme with the goal to contribute to poverty reduction in the target areas through increased incomes and access to productive assets. This includes improved productivity in the agriculture and livestock sector through a cost-sharing basis over 28,216 farm animals were vaccinated and 16,559 animals were de-wormed. 90 sets of poultry birds were in Quetta, Pishin and Mastung districts. 158 people were trained on poultry and livestock management.

ADP-B also includes improved water and irrigation systems through rehabilitation of karaizes & springs, construction of water reservoirs and channels, clean drinking water supply schemes and introduction of high-efficiency irrigation system. A total of such 49 schemes were implemented in which communities contributed Rs 4,402,145 million at 30 percent cost-sharing basis. As result of interventions, water availability was increased from 75,044 cft to 105,925 cft, with this increase an additional 400 acres of land is estimated to become cultivable.

Furthermore, ADP-B includes improved natural resource management through construction of water harvesting structures with over 250 acres to avail flood/rain water for agriculture/cropping. The installation of 5 greenhouses (in Loralai, Muslim Bagh and Kalat) for nurseries to introduce improved varieties of fruit trees increased production, and farmers were trained in water harvesting structures development and natural resource management.

Oct 2006 -Apr 2012: Community Development Project for Rehabilitation of Salt Affected & Waterlogged Lands (Bio Saline II)

The Bio Saline II project aims at developing sustainable farming systems for the rehabilitation of waterlogged and salt affected lands to improve livelihoods in three districts of Punjab, namely Hafizabad, Jhang, and Sargodha. Objectives include: Mobilizing communities to partner with the Government on agriculture and land rehabilitation schemes; Introduction and demonstration of improved agricultural techniques; and Improving access to services and markets.

## UNWHO

2011: Pakistan Floods Rapid Response Plan

The Pakistan Floods Rapid Response Plan launched on 18 September, 2011 covers the financial humanitarian needs for the first months of the relief efforts in Sindh Province. The Health and Nutrition Cluster seeks US$ 45.9 million, including US$ 14.8 million for WHO. The main objectives are to preserve and restore access to basic health care and to prevent, control and respond to communicable disease outbreaks. So far, enough medicines and supplies have been distributed for the provision of health care to 285 000 people for a month. WHO also provided 1040 clean delivery kits, 1550 anti snake venom kits and 1000 hygiene kits.

2008-2011: Global Roll Back Malaria (RBM)

At present, Pakistan is a member of WHO Global Roll Back Malaria (RBM) Initiative, with a commitment to intensify its efforts for effective control of malaria in the country. Since its inception in 1948, WHO has been the major technical partner with the Ministry of Health (MOH) in malaria control activities. Currently WHO provides technical and financial support to the RBM Programme for strengthening early diagnosis, prompt and effective treatment and epidemic control and operational research.

Objectives of the RBM Programme

1. To reduce malaria morbidity by 50 % by end of the year 2010
2. To reduce malaria mortality to minimum
3. To prevent and control malaria outbreaks

## WORLD BANK GROUP (WBG)

The World Bank does not work alone, but in cooperation with various groups including communities, civil society, government, and donor agencies. The joint effort of these groups is required to significantly reduce poverty. The World Bank provides technical expertise and funding in areas such as health, education, public administration, environmental protection, agriculture, and basic infrastructure.

Working with the government and civil society, the World Bank has developed an action plan known as the Pakistan Country Assistance Strategy which describes *what kind of support* and *how much* could be provided to the country beginning June, 2002 and covering a period two years . The strategy was designed to directly support the government's Povery Reduction Strategy and focuses on three key areas:

1) strengthening economic stability and government effectiveness;

2) strengthening the investment climate;

3) supporting pro-poor and pro-gender equity policies.

The World Bank Group's strategy and support to Pakistan is currently organized around four pillars: (i) improving economic governance; (ii) improving human development and social protection; (iii) improving infrastructure to support growth; and (iv) improving security and reducing the risk of conflict. Within these pillars, WBG aims for these transformational outcomes:

*Strengthening Tax Policy and Administration*: raising the ratio of tax to GDP (currently only

10.2 percent of GDP) is absolutely essential if Pakistan is to have the resources to invest in human development and infrastructure, and if it is to build resilience to future shocks and guard against costly and disruptive growth reversals.

*Expanding Power Provision*: reforming the power sector and ensuring sustainable expansion of supplies is absolutely essential if industrial and service activity is to be increased and productivity raised.

*Addressing Security**:*** coping with the consequence of conflict while reducing the prospects of future conflict is essential for long term growth. This is a highly complex area, and the Bank's competence and knowledge is evolving but limited. WBG will, however, make this a major thrust of their work, giving emphasis to service provision and job creation in highly vulnerable areas (and drawing upon emerging findings from the WDR and from work in Pakistan).

## ASIAN DEVELOPMENT BANK (ADB)

ADB's Country Partnership Strategy (CPS), 2009–2013 planned assistance of $4.4 billion through 2011, and annual average lending of almost $1.5 billion. The CPS provides the framework for ADB's partnership priorities and the future direction of its assistance strategy in Pakistan, and prioritizes the following four areas for ADB's support to Pakistan[10].

- Reforms and investments in key infrastructure sectors include support for power and energy, transport and the National Trade Corridor, and water resources. This assistance will reduce the cost of doing business and strengthen the underlying competitiveness of the economy.
- Support for a new generation of economic reforms will be provided by reducing distortions, accelerating market creation, and addressing governance and institutional bottlenecks. The government is addressing challenges with the help of financial assistance from partners,

[10] http://beta.adb.org/countries/pakistan/strategy

including an IMF-backed stabilization program. Institutional reforms to strengthen local fiscal and financial management systems, and a better environment for private sector investments, including through public-private partnerships, are needed.
- Development of urban services through pivotal interventions in Pakistani cities and secondary towns will unleash economic potential, while improving the quality of life of poor urban citizens.
- Effective implementation of projects and programs and capacity building will bring about greater aid effectiveness and sustainable development results.

## GERMAN GESELLSCHAFT FÜR INTERNATIONALE ZUSAMMENARBEIT (GIZ)

GIZ supports programs in basic education, health, renewable energy, good governance, and the special FATA Development Program.

FATA Development Programme

The GIZ FATA Development Program is anchored in the FATA Sustainable Development Plan (2006-2015) and operates in accordance with the Post Crisis Needs Assessment (PCNA). It pursues an integrated approach intended to enhance the credibility of the government by improving services, while also increasing the transparency of planning processes and allowing the population to assert their right to public services. Its many partners and target groups include project managers, staff of hospitals and schools, communities, elders and Jirgas, politicians, civil society representatives, the University of Peshawar, and professional and private provider associations. The programme consists of three components: education, health and livelihoods.

The main objective of the first phase of the livelihood component is to set up accountable community development funds for the implementation of small-scale and short-term projects in cooperation with communities, the local government and administrative agencies. In order to understand properly the environment in which it works, GIZ carries out objective livelihood analyses, context studies and exchanges with local development partners. At the same time the programme offers advice and training to the participants in the projects, to enhance their productive potential. Since agriculture is central to the FATA economy, it will be one of the focal points of this program.

## INTERNATIONAL CENTER FOR RESEARCH IN THE DRY AREAS (ICARDA)

In general, ICARDA’s research is focused on delivering solutions that can help improve the performance of farming systems and people’s livelihood the dry areas of the world. ICARDA works toward the improvement of barley, lentil and faba bean worldwide. It serves the non-tropical dry areas for the improvement of on-farm water use efficiency, rangeland and small-ruminant production.

In the Central and West Asia and North Africa region, ICARDA contributes to the improvement of bread and durum wheat varieties, kabuli chickpea, pasture and forage legumes, and associated farming systems.

ICARDA also works on improved land management, diversification of production systems, and value-added crop and livestock products. Social, economic and policy research is an integral component of ICARDA's research to better target poverty and to enhance the uptake and maximize impact of the research outputs.

ICARDA's international cooperation is built on its close relationships with national agricultural research systems (NARS) and other partners. ICARDA has a regional program covering dry, medium- to high-altitude areas in Afghanistan, Iran, Pakistan and Turkey. Many of ICARDA's research results and technologies, especially hybrid varieties of staple crops, reach Pakistan and farmers.

### INTERNATIONAL CENTER FOR RESEARCH IN SEMI-ARID TROPICS (ICRISAT)

ICRISAT, based in Hyderabad, performs the same tasks as its sister institution, ICARDA, above, but on different crops. ICRISAT conducts research on five highly nutritious, drought-tolerant crops – chickpea, pigeonpea, pearl millet, sorghum and groundnut. As with ICARDA, many of ICRISATs research results and technologies, especially new hybrid varieties, reach Pakistan and farmers.

## 2.3 PESTICIDE REGULATIONS AND IMPORT FROM NEIGHBORING COUNTRIES

Few to no pesticides enter Pakistan from Iran, Russia or Central Asian Republics. In fact, many pesticides are produced in Pakistan. China, India and Afghanistan serve as major supplier countries.

### CHINA

After the United States, China is the second largest producer of pesticides. Chinese factories and pesticide companies produce the active ingredients for both the top and bottom ends of the sector. Some of the better companies now are sub-contracted to produce active ingredients for pesticides in international brand-name companies. However, many of the rest of the companies flood developing world markets with the most popular chemicals that are easy to make, but may have contaminants or less active ingredient (AI) than advertised. In China, since 1963, the manufacture and sale of agricultural pesticides is regulated by the Ministry of Agriculture's Institute for the Control of Agrochemicals of the Ministry of Agriculture (ICAMA). Numerous Chinese products, some appearing with pirated international labels, can be found throughout the region. These are included in Annex 7.

### INDIA

Following the United States and China, India is the third largest producer of pesticides. According to http://www.bharatbook.com/detail.asp?id=53019 "The production of Indian pesticides industry has almost remained stable at 82000-85,000 MT during FY10. Exports formed 55.56% of total industry revenues in FY10 and have grown at a Compounded Annual Growth Rate (CAGR) of 37.59% from FY06 to FY10. Prior to 2005, i.e. in the process patent regime, Indian companies focused on applied research and concentrated on marketing generic and off-patent products. Due to this, the R&D expense by Indian companies was lower at approximately 1% of turnover.

Global [Multi-National Corporations (MNCs)] companies focused on high-end specialty products and dominated the market for patented new molecules. Globally, pesticides companies spend 8-10% of their turnover on R&D. However, with the onset of the product patent regime in India since 2005, the Indian companies will need to increase R&D expense to meet competition from MNCs. Alternatively Indian companies can be competitive in the area of Contract Research And Manufacturing Services (CRAMS). With the advent of the Integrated Pest Management (IPM) technique, the use of biopesticides and Genetically Modified (GM) seeds has increased."

India is one of the most dynamic generic pesticide manufactures in the world with approximately 60 technical grade pesticides being manufactured indigenously by around 125 producers consisting of large and medium scale enterprises (including 10 MNCs) and more than 500 pesticide formulators spread over the country[11]. The Insecticides Act, 1968 and Insecticides Rules, 1971 regulate the import, registration process, manufacture, sale, transport, distribution and use of insecticides (pesticides) with a view to prevent risk to human beings or animals and for all connected matters, throughout India. All pesticides have to necessarily undergo the registration process with the Central Insecticides Board & Registration Committee (CIB & RC) before they can be made available for use or sale.

### AFGHANISTAN

Due to years of conflict and no functional government, Afghanistan has no approved list of pesticides registered for manufacture, import and use; however, it is anticipated that pesticide regulations being presently (2010) drafted by MAIL (Ministry of Agriculture, Irrigation and Livestock) will lead, in the coming two to three years, to such a list. To counter the use of sub-standard pesticides entering from China and other countries, donors in Afghanistan are encouraging MAIL, input stores and farmers to import and use only name-brand pesticides from established international companies. Pesticide exports from Afghanistan importers/distributors to Pakistan are increasing rapidly. These are included in Annex 7.

## 2.4 POTENTIAL PESTICIDE USE SECTORS IN PAKISTAN

### SEED TREATMENT WITH PESTICIDES AND GMOS

Many USAID agriculture projects donate or assist with acquisition of quality hybrid crop seed for farmers they serve. Almost all of this seed, as well as practically all modern vegetable seeds are treated with pesticides (see the photo below of treated vegetable seeds of every color, from the region).

Most commercial seed treatment, by volume, is done by the company that produces and packages the seed, not by donors and not by farmers. And almost all treated seed is colored to show that it has been treated—this is so that it is not confused with food grain, not cooked and eaten.

Some farmers in Pakistan save seed from season to season and treat it themselves with at least one of the following pesticide products found available throughout the region: Raxil, Fundazole, Kalfigo Super, Maxim, Vitavax and Vinner. Generally seed-treatment pesticides are formulated as one of the following: FS = Flowable concentrate for Seed treatment (most seed treatments); DS = Powders for Dry Seed treatment; SC = Suspension Concentrate; WP = Wettable Powder; MD = Micro Dispersion; WS = Water dispersible powder for Slurry treatment.

[11] http://www.indiajuris.com/pest.pdf

*Photo: Pesticide-treated vegetable seeds for sale in the region*

## METHODS OF SEED TREATMENT

Seed Dressing: The most common method of seed treatment in which seed is either dressed with a dry formulation or wet treated with a slurry or liquid formulation. Dressings are applied both on-farm or in specialized seed treatment facilities. This is very common among majority of farmers in Pakistan. Farmers dress seed by simply mixing pesticide with seed in simple pot/tub or rotary machine (simple cement mixing) depending upon the size of the farm.

Seed Coating: A special binder is used with a formulation to enhance adherence to the seed which may impact seed size and shape. Coatings require advanced treatment application technology and it is not common in Pakistan.

Seed Pelleting: It is the most sophisticated seed treatment technology which is available in technically advanced countries. It includes changing the physical shape of a seed to enhance plantability and handling. Pelleting requires specialized application machinery and techniques and is the most expensive of the applications. This is not used in Pakistan at any level.

## SEED TREATMENT IN PAKISTAN

Mostly seed treatments are practiced for cotton, cereals oilseeds, and vegetable crops. However, only a small number of farmers treat their self-produced seeds. Seed supplying companies claim to market pre-treated seed. Some of the important seed treatment agrochemicals are noted in Annex 7, column 3 with an “S” for Seed.

## SAFETY OF WORKERS

Proper safety measures are recommended for the workers engaged in seed treatment such as use of gloves, goggles, cap, special clothes and gumboots.  However, these measures are rarely observed anywhere in Pakistan, except use of gloves. Farmers usually use a piece of cloth, a traditional dress (a type of turban) of farming community to cover their head and nose.

## GMOs

Pakistan, in 2001, signed The Cartagena Protocol on Biosafety to the Convention on Biological Diversity[12] and has since (2009) ratified it and entered it into force. However, to provide biosafety while using GMOs (Genetically Modified Organisms), and the effective use of biotechnologies, the following measures need to be taken: developing legislative and institutional base in this field; training specialists and creating a special body controlling the GMO management; and developing special programs on informing the population of genetically modified organisms.

However, USAID has Agency Procedures for Safe Use of Genetically Engineered Organisms[13]**.**  If a USAID-funded activity will potentially involve the use of genetically modified organisms in research, field trials, or dissemination, the activity must be reviewed and approved for compliance with applicable U.S. requirements by the USAID Biosafety Officer in Washington prior to obligation of funds and prior to the transfer, testing, or release of biotechnology products into the environment. This review and approval is limited to the safety aspects of the proposed activity and may involve external peer review or demonstration of comparable safety oversight by other expert U.S. federal agencies. Therefore, adequate time should be budgeted for this approval process. This biosafety determination is separate from, and precedes and informs, the 22 CFR 216 environmental impact assessment determination.

## ADVANTAGES OF SEED TREATMENTS AND GMOS

Since they are used at very small amounts of active ingredient per seed and thus per unit of land, and take the chemical directly to the pest, seed treatments with pesticides fit nicely within an IPM program.  They exert a much lighter impact on the environment than spraying an entire field. They protect the seed from numerous soil and seed-borne fungal, bacterial and insect pests, so that germination and seedling growth can proceed unimpeded.  And, there are some biological seed treatments available and some new ones being developed.  Use of some GMOs, like GMO cotton, can help reduce the number of pesticide sprays needed[14] to control boll-penetrating moth larvae.

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[12] http://www.cbd.int/countries/contacts.shtml?country=kg; http://bch.cbd.int/protocol/

[13] http://www.usaid.gov/our_work/environment/compliance/apsugeo.html

[14] http://www.ars.usda.gov/is/np/btcotton/btcotton.pdf

## RISKS FROM TREATING SEED WITH PESTICIDES ON-FARM AND GMOS

Treating seed involves many of the same risks as for mixing concentrated pesticide products and applying them to field or greenhouse crops. First, it assumes that the farmer knows the principle soil diseases and pests present and what to use against them. It also assumes that farmers understand the risks associated with treating, packaging, labeling, storing and planting the seed.

Ideally, seed would be treated in a specialized "seed treater" composed of a mixing tank, treater head and coating chamber to apply precisely measured quantities of pesticide. Proper PPE must be used by the farmer applicator and unused pesticide and residues must be properly disposed of. Next, the treated seed must be properly labeled as "Treated" with the common (Active Ingredient) and trade (Product) names of the pesticide used, health hazards of the pesticide such as skin or eye irritant, or if it is a carcinogen. For highly toxic chemicals, the statement "This seed is treated with a poison" and for toxic chemicals, the statement "Do not use for food, feed or oil purposes" should be used.

Seed treated for planting should be stored separately from grain to be used for food, animal feed or oil extraction. Storage should be in a dry, well ventilated space. Farmers should keep treated seed out of reach of small children. More BMPs for seed treatment are found on the following website: http://www.ksre.ksu.edu/library/entml2/s18.pdf.

USAID implementing partners are effectively limited to promoting or purchasing and donating only seed treatment pesticides or seed already treated with pesticides registered by EPA for same or similar uses. For this reason, this PERSUAP evaluates, in Annex 7, all of the AIs commonly found in seed treatment pesticides for EPA registration, human health and environmental risks, among other factors. Note again that the AIs commonly found in concentrated and formulated seed treatment pesticide products will present more application risks than seed already treated, due to a dilution effect.

Some GMO crops present risks as well as advantages. Risks include the development of pest resistance to the modified crop. So-called "super weeds" have developed from over-use of glyphosate (Roundup) on Roundup Ready soybeans[15]. Risks also include cross-pollination of GMO plants with open pollinated non-GMO crop plants, causing contamination. Further, many useful genes are inserted accompanied by other gene insertion sequences that may be human allergens.

## FIELD AGRICULTURE PESTICIDE USE

A large number of USAID development projects focus on increasing agricultural production and markets in countries where agriculture still consumes most of a country's labor, natural resources and GDP output. In Pakistan, in particular, several programs have aimed at assisting farmers where natural or man-made disasters have impacted livelihoods. Inevitably, these projects work to provide farmers access to improved varieties and tools, best practices and inputs. These inputs include fertilizers and pesticides. Pesticides promoted or donated include insecticides, miticides, nematocides, molluscicides, fungicides, herbicides, bactericides, avicides and rodenticides. Insecticides that are gaseous or produce toxic gas are called fumigants. Almost all field fumigants are for soil treatment and are used for high value crops (like strawberries in the USA). They kill almost everything in the soil, and are almost always Class I toxins (the most toxic).

[15] http://www.nytimes.com/2010/05/04/business/energy-environment/04weed.html; http://www.rodale.com/monsanto

Advantages of Field Agriculture Pesticide Treatments

Some pests and diseases significantly reduce yield and yield potential of certain crops. Pesticides, if used wisely and safely in an IPM program, can reduce pests and diseases to tolerable levels, leading to lower risk of crop damage and therefore sustained yield.

Risks from Field Agriculture Pesticide Treatments

Risks from use of pesticides in the field are numerous, but the highest risk is encountered when the container of pesticide is opened because of the potential for contact with a high concentration of the AI. Once the AI becomes mixed with water and sprayed, risk decreases somewhat, but not completely, due to dilution. Risk goes up with higher concentrations of AI and with higher AI acute toxicity classes.

As noted in the introduction, USAID implementing partners are effectively limited to discussing during training, promoting, purchasing or donating only pesticides registered by EPA for same or similar uses.

## GREENHOUSES TREATED WITH PESTICIDES

At present USAID funds numerous agriculture projects that focus at least in part on greenhouse production for high-value off-season crops like tomatoes, cucumbers and herbs. Greenhouse environments provide a variety of benefits for plant production; however, many greenhouses favor pest development as well. The warm, humid conditions and abundant food are ideal for pest populations to build up.

Natural enemies that serve to keep some pests under control in the field may be absent in the greenhouse. For these reasons, pest problems often develop more rapidly and are more severe in enclosed systems. Greenhouses generally tend most likely to be infested with very small crop pests like spider mites, aphids, whiteflies, thrips, scales, mealy bugs, leaf miners and fungus gnats. Common greenhouse diseases include powdery and downy mildews.

Advantages for Greenhouse Production

The primary advantage of using pesticides in a greenhouse is that the pests are trapped and cannot leave, increasing the chance that they will be poisoned. The use of biological controls (predators, parasitoids or diseases that attack pests) can be effective for the same reason. The website[16] maintained by the National Sustainable Agriculture Information Service contains numerous biological control resources for greenhouse production. And, many small pests can be excluded (and biological controls kept in) by using very fine mesh screens on greenhouse ventilation openings.

Risks from Treating Greenhouses with Pesticides

[16] http://attra.ncat.org/attra-pub/gh-ipm.html

The risk of phytotoxicity—the injury to plants by pesticides—is greater in a greenhouses where plants grow rapidly and are exceptionally succulent. The greenhouse environment is in some ways more challenging than the field in that it is an enclosed space where pesticides can become concentrated in the air, with little room for error for applicator safety.

Concentrated liquid formulations are generally more hazardous to the applicator than dry formulations as they may be easily absorbed through the skin. Aerosols and fogs usually penetrate dense foliage better than conventional sprays, so better pest control is achieved, but they pose greater risk to people of exposure through the eyes or by inhalation. Special metering or application equipment may be needed and some of the chemicals used may be highly toxic.

Many pesticides labeled for field use are prohibited for greenhouse use because of concerns about worker safety, phytotoxicity leading to crop injury, and/or pesticide resistance management. Regulation 216 applies to greenhouse production in the same way that it applies to field uses. In Annex 7, this PERSUAP evaluates AIs contained in the most common greenhouse pesticides.

## COTTON HARVEST AND DE-LINTING CHEMICALS

Although USAID rarely supports large-hectarage cash crops like cotton, there are issues associated with chemicals used on cotton for harvest and de-linting. If needed, the issues and best practices for dealing with cotton harvest chemicals can be found at http://www.ipm.ucdavis.edu/PMG/r114800111.html. For de-linting, risky high concentration sulfuric acid or very dangerous anhydrous hydrochloric acid gas are frequently used. Another, costly, technique is the use of fire to burn lint. Finally, a newer, safer technique using dilute sulfuric acid is the current recommended process. Chemical-resistant gloves, plastic face-shields, rubber splash-proof aprons and carbon-filter respirators[17] are required[18] for handling acids[19]. Prior to disposal, acids should be diluted or neutralized[20].

## STORED GRAIN AND FOOD WAREHOUSE PESTICIDE USE

Several species of insects, mites and rodents may infest grain in storage. The principal pests that cause damage are the adult and larval stages of beetles, and the larval stage of moths. Rodents (rats and mice) or their hair, urine and feces are another possible stored food contaminants. All may be a problem by their presence, either alive or dead, or in grain that is to be processed for food, or already processed. Stored-grain insects are known as “internal feeders” if they feed within the kernels, otherwise they are referred to as “external feeders.”

Stored grain and foods can be turned to dust and contaminants very quickly if a pest population is left unchecked. Generally, warehouses are fumigated to kill all pests at once and the fumigant of choice is aluminum phosphide (which produces highly toxic phosphine gas). Some warehouses use highly toxic methyl-bromide, but this chemical is being phased out of use world-wide due to concerns that it interacts with and decreases the ozone layer. Others may use carbon dioxide. These gases are especially effective against internal grain feeders as non-gas

[17] http://www.labsafety.com/refinfo/ezfacts/ezf320.htm
[18] http://www.cdc.gov/niosh/
[19] http://www.utdallas.edu/ehs/manuals/docs/acid_safety.pdf
[20] http://www.osha.gov/SLTC/healthguidelines/index.html

pesticides may not reach into the grain. But, all of these gasses are highly toxic to humans, so intense caution must be observed, and serious repeated training needs to be done. Several non-fumigants are also used.

Advantages of Warehouse Treatment

The warehouse environment is largely a sealed environment where pests—especially well hidden and protected pests inside grain and food—that are being controlled cannot escape, and are controlled with toxic gases. Bait boxes containing rodenticides can be placed near warehouses to control rodents attracted to the warehouse.

Risks from Treating Warehouses with Pesticides

The closed environment and use of highly toxic gases pose unique and potentially deadly risks to humans, especially if they are not trained and equipped properly. Fumigation personnel must be trained (and in most countries, certified) and present in a pair, have self-contained oxygen or specialized canister filter masks, a phosphine meter and chemical resistant gloves. Non-gas warehouse treatments also have specific best practices found at http://fcamin.nic.in/admin/an4.pdf. Most stored grain issues are dealt with using good sanitation practices. Regulation 216 applies to warehouse storage in the same way that it applies to other uses. In Annex 7, this PERSUAP evaluates AIs contained in the most common warehouse pesticides.

## AGRICULTURAL PRODUCE TREATMENT AND PRESERVATION

Many agricultural products are treated and preserved, from the household level to food assistance and commercial markets, and USAID is assisting with all of these. For instance, apricots shipped from the region to Russia and the USA are treated with sulfur, and many other products are treated with dilute chlorine solutions. Any fresh fruit and vegetable shipment traded between countries is generally treated with aluminum phosphide, producing phosphine gas, one of the most toxic chemicals known. At times, carbon dioxide, a natural but very toxic chemical is used for fumigation. Food additives and preservatives are the domain of the US Food and Drug Administration (FDA), not the EPA, and as such are not covered specifically under Regulation 216.

Advantages of Produce Treatment

All agricultural produce declines in quality with time and is attacked by microbes, insects and other pests. Thus, treatment with chemicals and by use of physical means (greatly raising or lowering temperatures, or decreasing moisture or water content) is essential to ensure food lasts until consumption, and that sanitary and phytosanitary needs have been addressed for international trade.

Risks Associated with Produce Treatment

Some naturally-occurring chemicals like salt, sugars, weak acids (citric, acetic) or sulfur compounds are relatively innocuous (sulfur was the first known pesticide used 4000 years ago in the Fertile Crescent). But others, like aluminum phosphide can be very dangerous to people who use it without sufficient training, safety equipment and warnings. Phosphides as well as chlorine, carbon dioxide and sulfur compounds are analyzed for safety in Annex 7. These are also discussed in the PER, and the FDA provides many resources for mitigating risks[21].

## VETERINARY PESTICIDE USE

Like field agricultural production, USAID also supports ways to increase production in countries reliant on pastoralism or livestock rearing for meat, milk, hides and other products. The singular important pest problem with livestock production involves the annoyance and transmission of diseases by ectoparasite ticks, mites and biting flies. Along with cultural practices and IVM, acaricides and insecticides are used to control these pests. In Annex 7, this PERSUAP evaluates AIs contained in the most common veterinary pesticides.

Animal or human food additives are regulated in the USA by the FDA[22] and not the EPA. They are referred to nowhere in Regulation 216, and are not considered to be pesticides. Thus, they are not covered in this programmatic umbrella PERSUAP.

Advantages of Veterinary Pesticide Use

Cattle diseased from tick or fly bites or bothered by biting flies lose weight and do not produce quantity or quality meat and hides. Acaricides and Insecticides reduce these risks.

Risks from Treating Livestock with Pesticides

One major risk from livestock treatment is the use of livestock dips whereby a deep pit is dug into the ground, generally next to a water source like a river or stream, and filled with a pesticide solution. Livestock are then run through and submerged in the dip. Disposal of the dip water once dipping is complete poses risks to the environment. Occasional floods overrun the dipping pit and carry the dip water down the stream, contaminating the water resource and killing aquatic organism. USAID generally does not support the use of dips.

Instead of dips, many ranchers now use backpack sprayers to apply acaricides directly to their livestock. More recently, herders and ranchers can apply acaricides using pour-on formulations. And, some without resources to purchase a sprayer apply acaricides by using a rag soaked in pesticides and applied using bare hands. But, in all of these instances, farmers should be encouraged to keep and use chemical-resistant gloves for these purposes.

## WATER AND SANITATION

Water disinfection/sanitization for household and drinking water use presents challenges. The primary chemicals used in Pakistan for water treatment are based on chlorine. Additional chemicals that can less commonly be used include those based on other halogens like bromine, iodine, as well as ozone and hydrogen peroxide. The Environmental Protection Agency provides a very nice summary of water quality

[21] http://www.fda.gov/food/foodingredientspackaging/ucm094211.htm
[22] http://www.fda.gov/AnimalVeterinary/Products/AnimalFoodFeeds/default.htm

standards and some guidance measures at http://water.epa.gov/scitech/swguidance/standards/handbook/index.cfm. The American Chemistry Council has some mitigation measures: http://www.americanchemistry.com/100years/Practices.html.

## BIRD FLU DISINFECTION AND MICROBIOCIDE USE[23]

HPAI virus can be serially transmitted between and among wild and domestic bird populations and can decimate domestic production and harm trade. Migrating wild birds may transfer HPAI long distances and across international borders, and are one source of the current outbreaks. Another source is the movement of infected birds in the commercial trade, both caged wild birds and poultry. The HPAI virus may also be transmitted to humans by direct contact with infected birds, body parts and waste, leading to sickness and potential death. The worst-case scenario is that the virus may mutate to become able to be transmitted from human to human, leading to an epidemic or pandemic.

USAID recognizes the highly pathogenic H5N1 avian influenzavirus as a threat to public health, economic stability, and development in affected and at-risk countries. Pakistan is considered to be HPAI epidemic country[24] and in the mid-2000s USAID and FAO contracted HPAI activities there.

HPAI activities involve extensive use of microbiocides to kill pathogens. These are the same as disinfectants used for cleaning water of pathogens. EPA's list of 100 disinfectant pesticide products registered for use against AI is at: http://www.epa.gov/pesticides/factsheets/avian_flu_products.htm. Thus, this PERSUAP will refer to and not duplicate this process. However, in Annex 7, this PERSUAP evaluates AIs contained in the most common water disinfectant microbiocides (pesticides).

Advantages for HPAI and Water Treatment

The HPAI virus and other microbial contaminants can be transmitted from dead birds, bird waste and bird parts. Disinfection reduces these risks. Water is also treated by many of the same microbiocides as well as by ultraviolet light.

Risks from Treating HPAI and Water with Pesticides

Water disinfection with chlorine gas from sodium chlorite and chloramines sometimes react with organic matter to produce side product chemicals, some of which are called trihalomethanes (THM). Mitigation of THMs includes reducing the amount of organic matter in water before treatment. Most disinfectants are Class I toxins and are highly corrosive to skin eyes and mucous membranes. Thus, they require the use of gloves, splash-proof safety glasses and a carbon-filtered face mask or respirator.

[23] http://www.usaid.gov/our_work/global_health/home/News/news_items/avian_influenza.html
[24] http://www.usaid.gov/our_work/global_health/home/News/ai_docs/ai_outbreaks.pdf

## MALARIA CONTROL PESTICIDE USE

Malaria acutely infects 300 to 500 million people worldwide, and 1 to 2.5 million people die annually due to the disease. Malaria is caused by protozoans of the genus *Plasmodium* which are transmitted to people living in at-risk areas by mosquitoes of the *Anopheles* genus. Malaria control involves reducing the populations of these mosquitoes and their transmission rates.

Malaria is endemic in most areas of Pakistan; however, USAID no longer works on malarial mosquito control there. In the future that could change if malaria once again reaches epidemic proportions. Rational activities might include the use of Indoor Residual Spraying (IRS) with an insecticide of mosquito resting sites on internal walls of adobe houses. Other activities could include the provision of insecticide-treated bed nets and area nets.

According to the UN, Pakistan's Roll Back Malaria (RBM) strategy is lagging far behind the international goal of reducing the disease worldwide by 50 percent by 2010, mainly because of a lack of skilled staff and a shortage of funding[25].

Risks with IRS and ITNs Technologies

Health and environmental risks from the use of IRS include risk to applicators if they do not use PPE properly and risks to inhabitants if they do not follow instructions for leaving the residence and covering belongings during and immediately following spraying. Water resources can be at risk; applicators must properly rinse their sprayers and dispose of leftover pesticide following best practices and away from open water sources. Other risks include the diversion of especially DDT, or other chemicals, from IRS to crop spraying, which is not recommended. USAID has produced a Programmatic Environmental Assessment (PEA) for IRS[26], and this document guides pesticide decision-making with IRS.

Health and environmental risks from the use of ITNs include potential exposure of humans and the environment during distribution, storage, use, and disposal of bed net re-treatment pesticides, mostly synthetic pyrethroids. The use of LLITNs, such as those used in Pakistan and throughout South Asia, avoids this because they last so long that they are never re-treated with pesticides. WHO-recommended ITN pesticide products are classified by EPA as only "moderately" toxic to humans, and with adequate safety precautions, the risk of adverse effects from their use is slight. However, these products are highly toxic to aquatic organisms, and precautions are necessary to assure that they not contaminate lakes, streams and other bodies of water supporting aquatic life. USAID has produced a PEA for ITNs[27], and this document guides pesticide decision-making with ITNs.

Mitigating Risks with IRS and ITNs Technologies

Where DDT is used for IRS, the primary risk is that the DDT will move out of the health sector to the agriculture sector and be used on crops. Strong governance in the IRS program and tight control over the DDT reduces the risk. Other application risks are mitigated with frequent training and refresher training on BMPs as well as provision and use of PPE. Risks to home occupants are mitigated by training and use of BMPs.

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[25] http://www.irinnews.org/InDepthMain.aspx?InDepthId=10&ReportId=33684&Country=Yes
[26] http://pdf.usaid.gov/pdf_docs/PNADI081.pdf
[27] http://pdf.usaid.gov/pdf_docs/PNACP696.pdf

ITN risks are reduced by use of LLITNs, which do not need retreatment. However, where non-long lasting bednets are used and retreated, the retreatment with synthetic pyrethroid pesticides lead to risks to water systems and skin irritation to applicators. Mitigation includes training and use of PPE, as well as use of only LLITNs.

### CONSTRUCTION PESTICIDE USE

Construction generally involves the use of best practices that avoid permitting standing water on-site and the use of best practices with pesticides to control future termite infestations in the structure(s) being erected. Malaria transmission is highest where there is standing water. Thus, the primary mitigation recommendation for reducing malaria transmission near construction sites is to avoid the presence of continuous (more than one week) standing water in puddles in borrow pits and open containers where malarial mosquitoes can breed. Thus borrow pits and open containers should be avoided and if they become filled with water, they should be emptied or treated with a mosquito larvicide. Such larvicides are evaluated in the PER and referenced Annex 7.

Termite control on construction sites involves best practices to avoid dumping wood scrap pieces or tree and stump remains as fill around the building foundation (a common practice) after erection. Most modern buildings in areas commonly infested by termites also apply a persistent termiticide to the soil around the foundation. IPM practices and permitted termiticides are found at the end of Annex 1.

## 2.5 PAKISTAN PESTICIDE SECTOR AND EVALUATION OF PAKISTAN PESTICIDE RISKS

### PAKISTAN PESTICIDE SECTOR

The involvement of private sector in pesticide activities made this a vibrant business venture. It had far-reaching effects on the overall agriculture of Pakistan. Private companies provided many incentives to farmers including credits and their contact with farmers was far better than provincial Agriculture Extension Departments. It posed pesticides as a single control measure for plant protection against insect pests hence played an important role in increasing over all use of pesticides.

The aggressive media campaigns especially on national television channel at prime time enhanced products promotion and subsequent usage by the farmers. Overall consumption reached a peak in the year 2004 when 129,598 metric tons were consumed. Afterwards the consumption has been reduced significantly and went down up to 40,463 metric tons in 2009 (see Table below). The main reason for this was the reduced pest pressure due to the introduction of resistant varieties, especially of BT cotton and lowering productivity of cotton and other cash crops.

Initially the pesticide business was in the grip of multinational companies, as importers preferred to import their products from manufacturing facilities abroad. Later, however, some local companies emerged and installed formulation facilities with the technical assistance and investment of China. There are currently 98 pesticide manufacturing/formulation plants presently operating in Pakistan. From the year 2000 onward the ratio of import to local manufacturing skewed towards local production.

### TABLE: PESTICIDE CONSUMPTION IN PAKISTAN

| Year | Imports (metric tons) | Production (metric tons) | Total (metric tons) |
|---|---|---|---|
| 1982 | 3552 | 1448 | 5000 |
| 1983 | 4875 | 1713 | 6588 |
| 1984 | 6081 | 3132 | 9213 |
| 1985 | 8270 | 4260 | 12530 |
| 1986 | 8834 | 5665 | 14499 |
| 1987 | 8019 | 6829 | 14848 |
| 1988 | 6256 | 6816 | 13072 |
| 1989 | 6869 | 7738 | 14607 |
| 1990 | 4802 | 9941 | 14743 |
| 1991 | 6157 | 14056 | 20213 |
| 1992 | 6691 | 16748 | 23439 |
| 1993 | 6128 | 14151 | 20279 |
| 1994 | 10693 | 14176 | 24869 |
| 1995 | 20134 | 23239 | 43373 |
| 1996 | 24151 | 19068 | 43219 |
| 1997 | 24168 | 13836 | 38004 |
| 1998 | 22765 | 18081 | 40846 |
| 1999 | 27210 | 18470 | 45680 |
| 2000 | 19764 | 41535 | 61299 |
| 2001 | 20678 | 26914 | 47592 |
| 2002 | 27103 | 42794 | 69897 |
| 2003 | 24028 | 54105 | 78133 |
| 2004 | 40482 | 89116 | 129598 |
| 2005 | 28371 | 76792 | 105164 |
| 2006 | 12721 | 30855 | 43576 |
| 2007 | 17939 | 76326 | 94265 |

| Year | Imports (metric tons) | Production (metric tons) | Total (metric tons) |
|---|---|---|---|
| 2008 | 9282 | 29904 | 39186 |
| 2009 | 5825 | 34818 | 40643 |

*Source: Agriculture Statistics of Pakistan 2009-10*

## PAKISTAN PESTICIDE USE PATTERNS

Pesticides consumption data suggest that the insecticides comprise of 90% of the total pesticides used in Pakistan followed by herbicides (7%), fungicides (3%) and acaricides & fumigants (0.2%). In 2010 and 2011, the trend continues. Higher insecticide usage is a constant phenomenon of Pakistan's agriculture. Use of herbicides is usually confined to only one application therefore its consumption always remains far low than insecticide use.

With regard to crops, the share of cotton crop is the highest (60.6%) of the total pesticides use in Pakistan followed by fruits and vegetables (11.9 %), wheat (9.7), paddy (8.3%) and sugarcane (4.6 %). Maximum numbers of sprays are carried out on cotton crop followed by fruits & vegetables and paddy (see Table below). Punjab has the highest percentage of pesticide use and 75.3% treated area belongs to this province followed by Sindh (22.4%) owing to high-cropped area in Punjab (see Table below). There is a downward trend of overall pesticide consumption in Punjab and Sindh due to declining use on cotton. However, it is escalating in Khyber Pakhtoonkhwa for the reason of increased use on fruits and vegetables.

### TABLE: AREA COVERED BY GROUND PLANT PROTECTION MEASURES (2009-10)

| Crop | Spray in hectares (000 ha) | Percent of total spray | No. of spray |
|---|---|---|---|
| Paddy | 2928.8 | 8.3 | 1.5-3 |
| Cotton | 21527.1 | 60.6 | 2-5 |
| Sugarcane | 1639.1 | 4.6 | 1 |
| Maize | 1245.2 | 3.5 | 1 |
| Wheat | 3455.5 | 9.7 | 1 |
| Oilseed | 420.5 | 1.2 | 1-3 |
| Tobacco | 58.6 | 0.2 | 1-3 |
| Fruits/vegetables | 4221.0 | 11.9 | 1-5 |
| Total | 35,495.6 | 100.0 | - |

*Source: Agriculture Statistics of Pakistan 2009-10*

### TABLE: PROVINCIAL USE OF PESTICIDE

| Province | Pesticide Spray (000 ha) | Percent of Total |
|---|---|---|
| Punjab | 27220.1 | 75.3 |
| Sindh | 8098.5 | 22.4 |
| Khyber Pukhtunkhwa | 647.3 | 1.8 |
| Balochistan | 177 | .5 |
| **Pakistan** | **34495.6** | **100** |

*Source: Agriculture Statistics of Pakistan 2009-10*

## PAKISTAN PESTICIDES PROFILE: FACTORS THAT INCREASE RISKS FROM AGROCHEMICALS

The use of pesticides in Pakistan began in 1952 with the introduction of an aerial spraying program on the key crops such as cotton, rice and sugarcane. In addition, pesticides were used for desert locust plague control, organized through an international network coordinated by the FAO. Since then, pesticide use has increased and spread to all crops and agricultural production.

According to World Wildlife Fund (http://www.wwfpak.org/toxics_chemical.php), "The pesticide business started in Pakistan in 1954 with the import of 254 metric tons of formulated product, increasing to 20,648 metric tons in 1986-87 and 44,872 tons in 1998. More than 70-80% of pesticides used in this country are being used on cotton crops. In 1997-98, pesticides were used on 93.9% of the total cropped area of cotton, 86.9% of sugar cane, 70% of rice paddy, and 14.5% of fruit and vegetables. Use of pesticides is increasing at the rate of 25% a year."

As the result of a strong media campaign by about 200 local, national and multinational companies with a distribution network of some 6,000 dealers, farmers believe that it is essential to use pesticides. The import bill of pesticides increased from Rs. 225 million in 1980-89 to Rs. 5,272 million in 1996-97. The sprayed area has increased from 1.8 million hectares to 3.8 million hectares (18% of the cropped area) in 1991. Due to a complex cropping system and small land holdings, ground spray is preferred, with aerial spraying restricted to epidemics. While playing a key role in protecting plants, pesticide use also causes problems like resistance in pests, persistence of toxins in the eco-system, and health problems for field workers, food consumers and dealers. According to a recent report by the Pakistan Agricultural Research Council (PARC), as many as 10,000 farmers are poisoned annually by indiscriminate use of pesticides in cotton growing rural areas only.

In February 2000, the Punjab Assembly was told that about 3,800 tons of obsolete and outdated pesticides were stored in the Punjab Agriculture Department warehouses, but could not be disposed off due to lack of funds. An estimated 1,935 stockpiles of obsolete pesticides in the 41 agriculturally active districts of Pakistan were threatening the lives of thousands of residents. In 2001, over 317 tons of these obsolete pesticides were removed by the Netherlands. As of 2011, many tons of obsolete pesticides remain, awaiting disposal.

Pesticide manufacture, import and usage are controlled by the 1971 Agricultural Pesticides Ordinance, and the 1973 Agriculture Pesticide Rules. As of 2011, 23 pesticides have been de-registered and their import banned. Most of these are Prior Informed Consent (PIC) and Persistent Organic

Pollutant (POPs) Treaty chemicals. Imports of banned pesticides, their illegal storage in godowns, pilferage from warehouses and adulteration are problems related to lack of implementation of the pesticide ordinance.

## PESTICIDE INFORMAL/ILLICIT IMPORT TO PAKISTAN

There are no accurate records on quantities or types of pesticides informally/illegally imported to Pakistan; however, there is evidence in markets that these imports exist. Proximity to India and China assures that low quality products will enter Pakistan and that many of these will not be registered and the label quality will be sub-optimal.

## PESTICIDE PRODUCTION IN PAKISTAN

The Country Report on International Code of Conduct on the Distribution and Use of Pesticides, http://www.fao.org/world/regional/rap/meetings/2005/Jul26/Documents/Pakistan%20Report.doc for Pakistan in 2005, notes that "Local manufacturing in the country is very limited and is restricted to Aluminium phosphide, Copper oxychloride and Zinc phosphide only. Local formulation has increased from 14% in 1984 to about 70% in 2004 of the total supply. There are over two dozen formulation plants in the country. For local formulation, the technical grade of a pesticide and other substances including emulsifiers, carriers, stabilizers and so on are imported separately, which, together with a solvent, generally xylene (locally available), are blended in precise proportions to produce the finished product. Due to increasing consumption of pesticides, different advanced technologies are required for new formulations."

## PESTICIDE PACKAGING, REPACKAGING & LABELING QUALITY IN PAKISTAN

Packaging

According to above-referenced report, "All packaging is done at registered plants using automatic/semi-automatic filling system. Most liquid pesticides, depending on their chemical nature, are filled in CO-EX and PET bottles or tin cans. Bottles have seals, caps and shrink wraps over them. Powder pesticides are packed in hermetically sealed sachets and granules are packed in plastic bags further contained in cotton bags. The packaging ensures that pesticides are not deteriorated during their shelf-lives as well as there is no leakage."

Repackaging

No manual re-packing/ re-filling is permitted. The formulators/re-packers are likewise required to have arrangements of safe storage, proper waste disposal and regular medical checkup of workers. The importers/formulators are required to undertake to supervise re-packing/re-filling and labeling processes carried out at a plant duly registered and pass on pesticides to the distributors, dealers/vendors only in retail packing. No person can store pesticides unless permission for the same is issued to him.

Labeling

The Agricultural Pesticides Rules provides an exhaustive guideline for labeling following the FAO Guideline covering necessary aspects of safety. Appropriate warning symbol in accordance with the WHO's recommendation is displayed on label. Withholding period of pesticides is also required to be mentioned.

Packaging and labeling quality is variable in Pakistan, with large multinational companies following recommended best practices and smaller companies from India and China not. Proximity to India and China assures that low quality products will enter Pakistan and that the packaging and label qualities will be sub-optimal. USAID project farmers will need to be informed of this trend and advised not to use sub-optimal products not properly packaged or labeled.

## CURRENT PESTICIDE CONSUMPTION IN THE AGRICULTURE SECTOR

Plant protection through the use of pesticides has grown from about 915 tons (230 tons active ingredient) in 1981 to 129,000 tons (28,500 tons of active ingredients) in 2004.

With regard to use, the most heavily treated crop is cotton followed by paddy rice, sugarcane, fruits and vegetables. By itself, cotton accounts for about 70% of the total consumption of pesticides active ingredient; this has resulted in the exceptional rise in cotton production in the country. In 2007, Pakistani farmers cut pesticide use on cotton significantly as a result of FAO FFS programs.[28]

## PAKISTAN'S PESTICIDE REGISTRATION AND REGULATION SYSTEM

Before 1971, pesticides to be imported were standardized by the Federal Government of Pakistan through Department of Plant Protection (DPP), since no rules and regulations were in place. In 1971, the Agricultural Pesticides Ordinance (APO) was promulgated to regulate import, manufacture, formulation, sale, distribution, use and advertisement of pesticides. In 1973, under this APO, Agricultural Pesticides Rules were made and the entire pesticide regulations were put under regular standardization and registration with the help of Provincial Agriculture Departments.

## PAKISTAN'S ABILITY TO ENFORCE REGULATIONS ON DISTRIBUTION, STORAGE, USE, & DISPOSAL OF PESTICIDES

National Legislation and Enforcement

According to a Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005), "National legislation exists in the form of Agricultural Pesticides Ordinance 1971 which is supported by the Agricultural Pesticides Rules 1973. The Rules are amended from time to with the approval of Agricultural Pesticides Technical Advisory Committee (APTAC). APTAC is at liberty to nominate sub committees and can entrust them specific duties.

Liberalization of pesticide trade had been welcomed because it had given benefit to the farmers. Unfortunately, this has not been entirely problem free. Some unscrupulous elements found opportunity to indulge in unethical activities such as:

- Formulating pesticides using active ingredient in substandard quantity
- Adulteration at supply chain, packing, distribution and marketing level

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[28] http://www.fao.org/newsroom/en/field/2007/1000497/index.html

These malpractices are affecting the plant protection quality and causing damage to the environment.

Testing, Quality Control and Effects in the Field

The legislation on the specifications of pesticides already exists in the Agricultural Pesticides Rules 1973. Method of analysis involves CIPAC, AOAC, PAC and others.

The check on the quality of pesticides, curbing the practice of sale of adulterated / sub-standard pesticides, is maintained through network of inspectors and pesticides laboratories. Officers of provincial Agriculture Department are appointed as inspectors. Their position is as follows:

| | |
|---|---|
| Punjab | 232 |
| Sindh | 74 |
| N.W.F.P. | 157 |
| Balochistan | 92 |
| Federal | 15 |

There are at present pesticides 10 laboratories with Public/Semi-Government sector, 29 with the private sector. Additionally under new legislation 50 repackaging units are also required to established pesticides laboratories.

## PAKISTAN HEALTH AND ENVIRONMENT POLICY AND MITIGATION

According to a Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005), Government with the coordination of industry takes care of human health and the Environment. Rules 37 to 41 specially mention all the requirements, which are necessary for Health and Environment. There are regular surveys on occupational poisoning cases among farmers and industrial workers. Two poison centers are established in the country. One is in Faisalabad and the other is in Karachi.

## PAKISTAN'S ADOPTION OF PRIOR INFORMED CONSENT (PIC) PROCEDURES

In 1999, Pakistan signed the PIC convention treaty. And, it has now banned the import all of the PIC chemicals. The extent to which additional PIC chemicals enter the country is not known, but it is certain to occur due to lack of sufficient border control and enforcement resources.

## CURRENT PESTICIDE STORAGE, HANDLING AND SAFETY PROCEDURES IN THE SECTOR BEING STUDIED

According to a Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005), the Government has taken measures to ensure safety in use of pesticides. Pesticides are not allowed to be produced by persons not having prior approval of their activities from the government. The government has enforced legislation requiring registration of pesticides dealers/venders, distributors, formulators and re-packers. The license for dealership/vending is issued only to a person who has been duly trained in safe storage, transportation and use of pesticides.

The distributors, inter alia, are required to employ adequate number of Agricultural Graduates to ensure safety in handling and judicious use of pesticides. The formulators/ re-packers are likewise required to have arrangements of safe storage, proper waste disposal and regular medical checkup of workers. No manual re-packing/ re-filling is permitted. The importers/formulators are required to undertake to supervise re-packing/re-filling and labeling processes carried out at a plant duly registered and pass on pesticides to the distributors, dealers/vendors only in retail packing. No person can store pesticides unless permission for the same is issued to him.

## PAKISTAN PESTICIDE APPLICATION METHODS

Foliar application through knap-sack/power sprayers is most popular, followed by the tractor-mounted sprayers. Some pesticides are sprayed by ULV sprayers as well, especially for locust plague control. Granular pesticides are broadcast manually. Use of protective clothing/gears is insufficient due to hot and humid conditions prevailing in the fields. Special protective clothing that is light and comfortable needs to be procured for USAID supported clients.

## PHASING OUT SEVERELY TOXIC PESTICIDES IN PAKISTAN

According to a Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005), "Pakistan is the one of the few countries in the region to have banned use of all severely toxic and hazardous pesticides included in the PIC and POP list in the early 1990s. In addition to PIC/POP pesticides, several other pesticides have also been banned. The government has also banned all formulations of monocrotophos and methamidophos. Regardless, POPs and PIC chemicals still enter Pakistan via informal routes. Endosulfan, banned and placed on the POPs list in 2011, is still registered for use in Pakistan and holds an important place in the cotton production inputs repertoire.

## ADDITIONAL PESTICIDE CHALLENGES IN PAKISTAN

A Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005) found the following challenges to pesticide use and safety:

Lack of Awareness

Pakistani farmers have inadequate knowledge about pesticides as to their suitability, application techniques and safety measures. This is one of the reasons of poor pest control, environmental pollution and health problems in some areas. Programs for guidance of the farmers in this respect are far and few. The pesticide industry does not put sufficient resources on dissemination of knowledge on pests, pesticides, environment and management techniques. In this area there is great scope of extension work in the public sector.

Identification of pest problem

The stage of a particular insect pest is extremely important while determining the need for chemical treatment. Many Pakistani farmers cannot correctly identify crop pests and diseases correctly.

Selection of pesticides

Normally selective chemicals appear to offer an almost ideal means of pest control. However, only a few such chemicals have been discovered and developed for commercial use. The pesticides that are harmless to predators and parasites are ideal for IPM program. Most Pakistani farmers do not understand pesticide selectivity. Pesticides like emamectin benzoate, abamectin and spinosad are known to be selective in their mode of action. Until more selective pesticides are commercially available at reasonable cost, more judicious use of pesticides should be made.

Under-dosing

Under dosing of pesticide brings more harm than benefit in the shape of triggering development of resistance in the pests. To get good control of pest, the recommended doses should be used. Sometimes the farmers reduce the dose thinking that the pest pressure is low. Under dosing is helping in the resurgence of the pests. Insects develop resistance to insecticides more rapidly if under dosing is used. Small farmers tend to use less dose of pesticide.

Lack of Use of Safety Equipment/PPE

One USAID I-LED staff in 2007 said it all with the following: "Inshallah we'll get some IPM/pesticide training that might reduce use but realistically farmers are unlikely to follow most pesticide dosages or PPE recommendations as equipment is uncomfortable to wear/expensive but more to the point they fail to see the need despite the fact that they know these are poisonous. Best we might hope for is for them to wear an old shalwal-kamise and change out of this after spraying/handling chemicals but unlikely shoes or boots. And perhaps washing with soap as well as water but that might be hoping for too much."

## OBSOLETE PESTICIDES IN PAKISTAN

The national Pakistani Agricultural Pesticides Rules state that: "the destruction and removal of the empty packages and pesticides remains shall be affected in such a manner that sources of water supply are not contaminated. The unclean packages shall be destroyed in a way as to preclude the possibility of their being reused for any purpose other than as base material. Further procedures for disposal of surplus pesticides and pesticides containers have been notified in 1984 encompassing small use, commercial and municipal use, in situ-disposal; organized disposal and landfill disposal sites."

Still, according to (http://www.unescap.org/DRPAD/VC/CONFERENCE/ex_pk_17_dop.htm) the United Nations, Pakistan holds a large stock of obsolete pesticides. The stocks accumulated up until 1980, when national pesticide requirements were purchased centrally by the Government. The quantity has been estimated to lie between 3,000 and 5,000 tons. The stocks are held in an estimated 200 major stores (ton quantities) and up to 1,700 Field Assistant stores (typically containing tens to hundreds of kilograms). The stocks are predominantly in the cotton growing areas of the Provinces of Sind and Punjab, but there are also stocks in Northwest Frontier Province and Balochistan.

The stocks comprise a large range of formulated pesticide types predominantly organophosphate and organochlorine insecticides. The main hazard associated with the pesticides is their acute toxicity, with some of the product active ingredients falling within the highest category of toxicity according to the WHO system of classification, namely "extremely hazardous". The stocks, having been held for around two decades or more, are now in a dilapidated condition, with considerable leakage, and pilferage. This presents a serious risk to those who have to enter the stores. Because store integrity and security is not good in some locations, it also presents a serious risk to the local communities and to the environment. There is apparently some evidence of contaminated wells. There have been complaints and expressions of concern from some communities.

Fortunately, after pesticide purchase moved to the private sector in 1980, there has been little subsequent accumulation of pesticide stock sand hence further stock accumulation is not seen as a problem for the future. The problem can, therefore, be restricted to how to collect and dispose of the existing obsolete stocks in a safe and environmentally responsible manner.

There have been several significant past initiatives to deal with the problem. The first was in 1987 when USAID sponsored the visit to Pakistan of a team of hazardous waste disposal experts to assess the situation. The team estimated the stocks and associated hazardous materials at some 8,000 tones. Some of the stores visited were considered to present a serious danger to those entering them. The team made recommendations for the disposal of the stocks.

Following the above visit, USAID and USEPA, in collaboration with the Government of Pakistan and other, carried out a disposal experiment (1.5 tons of pesticide) using a modern cement kiln at D.G. Khan. Although the experiment was claimed a technical success, there was controversy related to apparent bird deaths and a safety concern from the nearby community, and a local opposition to cement kiln use developed.

Subsequently a proposal to dump these expired pesticides in the desert areas of Punjab province remained under consideration of the provincial government. In fact some land fill sites were also prepared. However, before implementation could progress, several NGOs voiced their concern against this approach from environmental point of view. As a result this proposal was shelved.

Later on, several other half-hearted attempts to deal with the problem remained under consideration. None came to fruition, partially due to the inability of the Government organizations to find a viable solution to this problem as well as public opposition of any unscientifically proven method of disposal of these expired pesticides.

The unsuccessful results of past efforts in this regard brought The Royal Netherlands Embassy (RNE), Islamabad aware of this problem in 1996 relating to the obsolete stock problem and the potential serious risk it presented. It was also recognized that some of the stocks may have originated from the Netherlands and hence they must be called to assist in the disposal of the pesticide stocks. Against this background the RNE commissioned a full-scale study with the following findings:

The current level of stock is not known, neither are the numbers of stores and their locations. The best estimate is 3,000 tons of pesticide stocks and perhaps 500 tons of associated waste.

There are well established procedures and technical options for dealing with the problem, and they have been used successfully in a number of recent (albeit smaller) international projects.  The only generally acceptable disposal process for the collected stocks and waste is high temperature incineration in special incinerators having flu gas treatment units that meet internationally acceptable emission standards. Most of the merchant incinerators are located in Europe.

A number of international hazardous waste disposal companies have submitted offers for undertaking the work, involving offshore incineration.

Although the stock repacking and site clean-up elements are well defined procedurally, there are several final disposal options (all involving high temperature incineration). The options are:

- Off-shore incineration in Europe
- Off-shore incineration in India
- Incineration in local cement kilns
- Installing a local rotary kiln incinerator in Pakistan.

On the basis of above, a Scoping Inventory is being prepared to identify those stores and stocks posing the greatest risk to the communities. Following a Pilot Project would be considered out to collect and dispose, by offshore incineration in Europe, of 500 tons of the highest risk stocks/stores. Happening in concurrently, is the task to carry out a detailed inventory of the remaining stores and train a local team to carry out the hazardous and complex task of subsequent site clean-ups and product repacking. This project is estimated to cost US$ 2.2 million, including Scoping Inventory and would be implemented in about 2 years.

Once the detailed inventory produced during the Pilot Project becomes available, a feasibility study of the local rotary kiln and regional options would be completed, cost-estimated and evaluated, then to be followed by the collection and disposal of the remaining some 3,000 tones of stocks and associated materials. The outcome of this could either be to continue with offshore incineration or to switch to one of the other options (or a mix).

The latest proposal prima facia supported by the donor has yet to achieve full national consensus on the soundness of the approach and its technical efficiency on which consultation must commence immediately for their widest acceptance and support.

Crop Life International points out that “in 2001, a pilot project initiated and sponsored by the Royal Netherlands Embassy (RNE) in Islamabad, was completed. On behalf of the RNE, the Pesticide Disposal Project of GTZ managed and carried out the basic survey for the disposal operation, the safeguarding and disposal of 323 tons of obsolete pesticides and associated waste from 13 high risk stores in the Province of Punjab and a complete survey of all 168 pesticide stores in Punjab Province. The 13 warehouses were owned by the Punjab Department of Agriculture and the stocks had been held since the late 1970s. Member companies of CropLife International paid the cost of incineration of 94 tons of the products (those they had either manufactured or supplied). The collection, re-packing, cleaning of storage areas, shipping and incineration activities were undertaken by AVR, the Dutch hazardous waste disposal company, subcontracted and supervised by GTZ. The GTZ survey indicated that there might be around another 1000 tons of obsolete stocks in the Province of Punjab. The Pakistan authorities hope that new donors will help fund further projects to collect and destroy these stocks.

In 2001, GTZ, the Environmental Protection Agency (EPA) of the North West Frontier Province of Pakistan and Bayer CropScience successfully completed an obsolete stocks disposal project in Peshawar, the provincial capital. Sixty tons of Gusathion, an insecticide for cotton – purchased by the government some 20 years ago – had been mistakenly transported to a government warehouse in a non-cotton growing area. As a result it lay unused and eventually deteriorated. The Pesticide Disposal Project of GTZ managed and carried out the collection and disposal operation. The product was repacked and transported to the United Kingdom, where it was incinerated by Shanks. GTZ and Bayer CropScience shared the technical and financial contributions.

In 2004, discussions were initiated between the Pakistan Environmental Protection Agency and GTZ for the collection and disposal of 15 tons of dust containing low levels of endrin, held at a depot at Malir, near Karachi. Shell, one of the original manufacturers of endrin, was to fund the project. However, before the project could start, the depot was cleared of pesticides and the site redeveloped. Until 1980, all pesticides in Pakistan were purchased centrally and then distributed to farmers. A private market was subsequently introduced, which had the beneficial effect of reducing considerably the accumulation of obsolete stocks.

The following table consolidates and prioritizes pesticide system risk in Pakistan:

| Problems, constraints or risks in the Pakistan pesticide cycle of use | Recommendations for donors and USAID projects | USAID Priority |
|---|---|---|
| Banned POPs and PIC chemicals still enter Pakistan via informal channels | Sensitize GOP officials about the threats to Pakistan's trade potential, and do training | High |
| Large quantities of obsolete pesticides, including POPs and PIC chemicals, remain | Combine resources from several donors to implement disposal programs | Med |
| Lower quality, illegal & pirated Chinese AIs and pesticides present | Do repeated training on pesticide quality choices | Med |
| Funds for analyzing and monitoring pesticides and residues is insufficient | Donors and produce exporters and authorities combine resources | Med |
| Limited resources for pesticide regulations enforcement | Taxes need to be levied from agriculture sector | Low |
| Limited resources for extension | Do demonstration farms and field days | High |
| Lack of pesticide toxicity awareness by farmers | Do repeated training on pesticide choice and risks | Med |
| Limited farmer knowledge of pest Identificaiton (ID) & IPM tools | Increase knowledge, do repeated training on IPM | High |
| Over- and under-applications of pesticides | Do repeated training on calibration & application | Med |
| Illiterate farmers cannot read pesticide labels | Do repeated training on pesticide cautions | High |
| Wrong pesticide applied for pest | Do repeated training on pesticide choice | High |
| Proximity to major cotton, tobacco and rice | Diversify production, knowledge & input | High |

| Problems, constraints or risks in the Pakistan pesticide cycle of use | Recommendations for donors and USAID projects | USAID Priority |
|---|---|---|
| production & chemicals | demand | |
| Pesticide shops with limited safety equipment (PPE) on hand | Train shop-keepers and farmers on proper pesticide safety | Med |
| Pesticides subdivided into unlabelled containers, like empty water bottles, and sold | Train shop-keepers and farmers on proper pesticide safety | Med |
| Pesticides stored in the home, often in unlabelled containers | Do repeated training on proper pesticide storage | High |
| Pesticide mixing with bare hands and little use of PPE by pesticide appliers | Do training on proper mixing and PPE to use; provide PPE | High |
| Pesticides applied at wrong time of day and with winds too high, and rain | Do repeated training on application times risks | Med |
| Back-pack sprayers leak onto spray personnel | Do repeated training on sprayer maintenance | High |
| DDT and endosulfan available in bazaars and stores, and used | Do repeated training on pesticide choice & quality | High |
| Toxic aluminum phosphide present in input stores | Do repeated training on pesticide choice & quality | High |
| Locust outbreak pesticide over-donations are sold to farmers | Pesticide donation programs need better inventory control | Low |
| Proper unused pesticides & empty container disposal lacking | Do repeated training on proper disposal | High |

## PAKISTAN PESTICIDES PROFILE: FACTORS THAT REDUCE RISKS FROM PESTICIDES

Reduced risk inherent in the cropping and input systems in Pakistan

- Many less toxic products are being registered and used by farmers in Pakistan, than compared with just 8 years ago when some highly toxic chemicals were still being registered and promoted.
- Many farm stores in developing countries are beginning to stock ever-increasing quantities of green-label biological pesticides (like neem oil, BT, oils with copper and sulfur, and extracts of garlic and chili pepper) made in India or Pakistan for both organic and conventional markets.

- Lower costs for biologically-derived, highly effective and approved for Organic insecticide products like spinosad, an extract from a soil bacterium are now a reality. Many newer nicotinoid insecticides are also now available.
- The fact that Pakistan will, in many cases, have to follow European standards systems in order to reach European markets. Many farms oriented for export will be ever more organized following S&C systems like GlobalGAP, Organic, Fair Trade and others, which inevitably contain recommended IPM measures that work and reduced-risk pesticide products.
- The increasing world-wide availability and use of small, single-use sachets and smaller bottles of pesticides (as opposed to one and five liter bottles) with labels containing important and potentially life-saving information (in local languages) that are marketed by the formal pesticide importer/distributor sector. These small quantities and labels help resolve on-farm pesticide quantity storage, illegal subdividing and use issues.
- The likely small scale of most USAID-supported beneficiary farms, combined with lack of financial resources, will limit the quantities of synthetic pesticides used, and will promote the use of other cultural techniques to solve pest issues.

**Conclusion:** There still remain some issues with pesticides that can increase the risk for errors to occur, and thus the risks that farmers, laborers, farm family members, and even international consumers may be acutely or slowly poisoned and/or their environment may become polluted and damaged. Thus the pesticide risk profile for Pakistan is higher than might be encountered in some more developed as well as other developing countries, though it is rapidly changing for the better as S&C-GAP systems are being implemented and EU rules for import tolerances are adopted. Extra care will be needed with emphasizing and implementing mitigation measures that work.

## 2.6 CLIMATE CHANGE AND PAKISTAN AGRICULTURE

Many man-made factors, including consequences of increased agricultural production, likely exacerbate global climate changes. Water-logging and indiscriminate use of nitrogen-containing fertilizers increases nitrous oxide emissions from croplands. These may increase the rate of organic matter decomposition, the release of gasses that exacerbate global warming, and soil degradation.

According to several sources, livestock and livestock-related activities such as deforestation, as well as increasingly fuel-intensive farming practices, are responsible for over 18% of human-made greenhouse gas emissions, including:

- 9% of global carbon dioxide emissions
- 35-40% of global methane emissions (chiefly due to enteric livestock fermentation and manure decomposition)
- 64% of global nitrous oxide emissions (chiefly due to fertilizer use)

Enteric fermentation leads to the production of methane. Methane is a greenhouse gas that has 56 times more global warming potential than carbon dioxide over a 20-year time horizon. Furthermore, clearing wild or forest land for new grazing areas or crop fields reduces the land's ability to act as a carbon sink.

Setting fire to vegetation to clear land or promote new growth for livestock to graze on may also contribute some to global warming. Destruction of forage areas can increase the rate of desertification, impacting climate change. It can also alter the earth's land cover, which can change its ability to absorb or reflect heat and light. Carbon dioxide can be produced, and electricity used, during production of synthetic pesticides, mineral fertilizers and animal feeds. Some nitrous oxide is produced by livestock manure, but composting reduces this.

Decreased water availability during dry seasons as well as new or increased insect pest and disease incidence will likely decrease crop yields in most tropical and sub- tropical regions. In Africa and Latin America many rain-fed crops are near their maximum temperature tolerance. Small climate changes that increase temperatures—even incrementally—can cause yields to fall precipitously. Various studies in South Asia and China have established that just a 1 degree Celsius increase in temperature during the wheat growing season may cause a decline in yield of 3 percent. In fact, decreases in agricultural productivity of up to 30% over the 21st century are projected. Marine life and the fishing industry will also be severely affected in some places as water temperature and acidity increase, leading to coral bleaching, reduced food chain plankton production and the resultant reductions in fisheries used for human food.

Increases in temperatures will favor the spread of insect and disease pests further toward more northerly and southerly extremes. Many pests which would die while overwintering will now survive. The increase in crop pests will lead to the use of more pesticides, which will increase the resistance of pests to these pesticides. And, human diseases such as malaria have increased in recent years and are moving steadily northward in their range.

Because of illegal tree cuttings, both for wood sale and clearing farmland, the $CO_2$ sequestration by forests and other forest biomass has decreased. As a result of changes in land use and reclamation of new lands, $CO_2$ absorption by soils has increased. Then, $CO_2$ emissions released have increased, due to the intensive use of soils.
The safety of agricultural crops and fisheries also may be threatened through contamination with metals, chemicals, and other toxicants that may be released into the environment as a result of extreme weather events, particularly flooding, drought, and wildfires, due to climate change[29]. All of these factors combined will challenge food quality and security.

In the summer of 2010, unusually heavy monsoon rains in Pakistan, likely due to global climate changes, displaced some 14 million people, and killed over 1,000. Floods and soil water-logging hamper planting. The current rapid retreat of mountain snow cover and glaciers is also attributed to increased temperatures due to global warming. Since about 70 % of Pakistan is considered arid or semi-arid, reliance on dependable but not overabundant rains is critical. Any deviations—from drought to flooding—will upset the balance required for basic agricultural production.

Challenges in reducing or reversing global warming include finding land-use strategies and crops that restore degraded ecosystems and soils by improving water use efficiency, enhancing soil quality and sequestering carbon in soil biomass. The use of irrigation—especially irrigation such as drip that conserves water—can reduce reliance on erratic and often unreliable rains. By using forage and fodder instead of manufactured livestock feed, livestock gut digestion is improved, reducing methane production. Composting manure can reduce the amounts of nitrous oxide produced by livestock manure.

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[29] http://www.cdc.gov/climatechange/effects/foodborne.htm

The use of manure instead of chemical fertilizers reduces the burning of fossil fuels for the production of mineral fertilizers. By using forage and fodder instead of manufactured livestock feed, livestock gut digestion is improved, reducing methane production. Proper pasture use and stocking can decrease overall numbers of livestock required at the beginning of a season, thus decreasing methane production.

The ever-lengthening Pakistani summer season no longer has a sufficient early-season cool component needed for wheat germination. Environmentalists and scientists say that Pakistan should urgently promote alternative crops to wheat because, as temperatures rise due to global warming, yields of the grain that is a staple food for most Pakistanis are predicted to fall[30]. Pakistan's efforts in these areas are still at an early stage.

Before the Global Change Impact Studies Centre was set up in 2001, there was almost no climate change research in the country. The center established a task force on climate change in October 2008, and submitted a comprehensive report in February of 2010 which outlines ways to respond to the challenges of global warming in Pakistan's water, agriculture and forest sectors. One agriculture university has developed drought- and flood-resistant crop varieties, including a "Maxipak" wheat strain that is only one foot tall and can withstand heavy rains.

[30] http://reliefweb.int/node/371883

# SECTION 3: PESTICIDE EVALUATION REPORT

This part of the PERSUAP, the PER (Pesticide Evaluation Report), addresses pesticide choices based upon environmental and human health issues, uses, alternate options, IPM, biodiversity, conservation, training, PPE options, monitoring and mitigation recommendations according to the twelve Regulation 216.3(b)(1) Pesticide Procedures Factors, outlined and analyzed below.

Reg. 216.3(b)(1)(i) stipulates: "When a project includes assistance for procurement or use, or both, of pesticides registered for the same or similar uses by USEPA without restriction, the Initial Environmental Examination for the project shall include a separate section evaluating the economic, social and environmental risks and benefits of the planned pesticide use to determine whether the use may result in significant environmental impact. Factors to be considered in such an evaluation shall include, but not be limited to the following:" (see box, right)

**THE 12 PESTICIDE FACTORS**

***Factor A**. USEPA Registration Status of the Proposed Pesticides*
***Factor B**. Basis for Selection of Pesticides*
***Factor C.** Extent to which the proposed pesticide use is, or could be, part of an IPM program*
***Factor D**. Proposed method or methods of application, including the availability of application and safety equipment*
***Factor E.** Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards*
***Factor F.** Effectiveness of the requested pesticide for the proposed use*
***Factor G**. Compatibility of the proposed pesticide use with target and non-target ecosystems*
***Factor H.** Conditions under which the pesticide is to be used, including climate, geography, hydrology, and soils*
***Factor I**. Availability of other pesticides or non-chemical control methods*
***Factor J**. Host country's ability to regulate or control the distribution, storage, use, and disposal of the requested pesticide*
***Factor K**. Provision for training of users and applicators.*
***Factor L**. Provision made for monitoring the use and effectiveness of each pesticide*

Pesticides can be home-made (artisanal) or synthesized in a factory, and may contain either natural extracts from plants, microbes, spices, oils, minerals or synthesized chemicals, or occasionally both. Pesticides generally contain more than just the AI; they also contain a carrier (water, oil, or emulsion), emulsifiers, synergists, safeners, adhesives and other components.

Pesticides generally contain just one AI, but can contain more than one AI, in a mixture. When produced commercially, each pesticide is made, marketed and sold with a product commercial name. This name, in addition to artisanal products, is the "pesticide" referred to by Regulation 216. These pesticide names can be ubiquitous (like Roundup for products containing the AI glyphosate) or can be given different names in different countries or regions depending upon cultural and linguistic differences and clever marketing.

It would be ideal to find pesticides for every need that are Class IV acute toxicity, have no chronic human health issues, no water pollution issues and no aquatic ecotoxicity issues. Such pesticides do not exist. Almost every pesticide known has toxicity to at least one aquatic organism, or bees, or birds.

Pesticide AIs used for general and field use spraying—as well as each of the other special use sectors—are analyzed in Annex 7 of this PERSUAP, with the codes for special sector uses in column 3, as follows:

Seed = S
Greenhouse Crops = G
Food Security/Warehouses = W
Veterinary = V
Health/Malaria = M
Construction/Termites = T
Microbial Disinfectants (Water, Sanitation and Avian Influenza) = D

## 3.1 FACTOR A: USEPA REGISTRATION STATUS OF THE PROPOSED PESTICIDE

Pakistan assistance projects activities are effectively limited to mentioning during training, promoting, recommending, subsidizing or purchasing pesticides containing active ingredients (AIs) in products registered in the host country and in the US by the EPA for the same or *similar* uses. Emphasis is placed on "similar use" because a few of the crops and their pest species found overseas are not present in the US, and therefore pesticides may not be registered for the exact same use, but often are registered for similar pests and pest situations. Annex 7 provides EPA registration status for each AI found in each pesticide registered for import and use in Pakistan.

### ISSUE: PRODUCTS CONTAINING ACTIVE INGREDIENTS NOT EPA-REGISTERED

Annex 7 shows in column 4 pesticide AIs in no EPA-registered pesticides and colors each one with red shading, meaning "Do Not Use on USAID Projects". Annex 7 colors with green pesticide AIs that pass all of the 12 factor safety analyses found in this PER, and possess "acceptable risks". This means that the AIs are in products registered for import and use in Pakistan that are also registered by EPA for same or similar use, not RUP pesticides, generally not Class I pesticides, not known carcinogens, and not known water pollutants. The fourth column of the table in Annex 7 shows EPA registration status of each pesticide AI. The fifth column shows whether or not there are RUP products containing that particular AI, with an indication of the relative amount that are RUP (few, some, most, all).

Pesticide AIs colored in yellow are EPA registered and can be used—with caution. They generally require additional measures to ensure acceptable safety. In cases where there are few, some or most RUP products, PERSUAP users can do simple web searches that show which products are RUP and which are not RUP. Furthermore, at the end or bottom of Annex 7, there are websites to which readers/users can directly link to get the most up-to-date RUP analyses. In cases where there are choices among Classes I, II or III pesticide products, users should always (with few exceptions where there are no choices and there are guaranteed options for safety) choose the least toxic product that will accomplish the task, and not use Class I chemicals because they are too toxic for the untrained and unprotected to use.

Pesticide AIs colored in red are either not EPA registered, banned or being phased out internationally, mostly Class I, Ia or Ib, are known carcinogens or known water pollutants. These are recommended *not* to be used on USAID-funded projects due to lack of compliance with

Regulation 216 and presence of unacceptable risks given the current knowledge of the Pakistan pesticide system risk profile as compiled above in Section 2.5.

Pesticide AIs that are not registered by EPA are either cancelled for use in the USA due to unacceptable risks, or have insufficient market demand and have thus not been through EPA's battery of environmental and human health tests. Pakistani farmers and others can buy and use whatever pesticides they want with their own resources, as long as these pesticides or the products they are sprayed on do not enter USAID-funded activities.

Recommendations for Mitigation

- Pakistan projects' beneficiaries not use with USAID resources products containing these active ingredients that are not EPA registered (colored in red).

### ISSUE: RESTRICTED USE PESTICIDES (RUPS)

The EPA has developed a system for dealing with pesticides with inordinate risks to human health and/or environment for various uses. In the USA, farmers who wish to purchase and use RUPs must receive (and pay for) specialized training and certification to increase awareness of the risks and ways that can be used to mitigate these risks. These *Certified Applicators*, or those under their direct supervision, must follow the pesticide label instructions and only use the product for purposes covered under their certification. Further, in the USA, some states may require that certain active ingredients not listed on the Federal list be classified as "restricted" in their states due to local conditions, generally related to environmental concerns.

The EPA classifies a particular pesticide as restricted if it determines that the pesticide may be hazardous to human health or to the environment *even when used according to the label*.

As noted above, in quotes under 3.0, Regulation 216.3 (b)(1)(i), "pesticides registered for the same or similar uses by USEPA *without restriction…*". The interpretation of "without restriction" is that approved pesticide products will not be RUPs, regardless of RUP criteria or basis (the reason they are designated as RUPs). It is important to note that RUP products may be designated as such, by EPA, due to either: 1. Inordinate risk (hazard) to users; or 2. Inordinate risk to the environment; or 3. Sometimes both. Regulation 216 considers this distinction and deals with it in subparts (ii) and (iii). The 1990 US Farm Bill requires all RUP applicators to keep accurate records of RUP use[31].

Annex 7 shows in column 5 whether or not each AI is present in RUP products, with relative quantities of RUP products containing each AI. Some of these are shaded red, meaning Do Not Use on USAID Projects, while some are shaded yellow, meaning "Caution, Investigate Further or Use with Care on USAID Projects". Some products containing these AIs have issues and some are designated as RUPs (but others are not, so

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31 http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateQ&navID=PesticideRecordkeepingProgram&rightNav1=PesticideRecordkeepingProgram&topNav=&leftNav=ScienceandLaboratories&page=PesticideRecordkeepingProgram&resultType=

extra investigation is required). Therefore, several of the pesticide products being made in or imported to Pakistan are designated as RUPs by the USEPA (compiled in Annex 7, column 5) and these specific RUP products are not to be promoted or used on Pakistan assistance projects. However, distinctions and references are provided to EPA-designated non-RUP products containing the same AI as other products which are RUP.

Recommendations for Mitigation

- Pakistan assistance projects' beneficiaries do not use *pesticide products* that are designated by EPA to be RUP (see Annex 7 with references to similar products containing the same AIs, but that are not designated as RUPs).
- Using information in Annex 1, do training on GAPs/IPM, the production and use of pest management plans and safe pesticide use and management. Training will introduce beneficiary farmers to: Pesticides not permitted for use, those the project recommends, and those that might be used with significant training and certification; IPM philosophy, tools and tactics; and Safe Pesticide Use practices including use of basic PPE.
- All USAID project offices should have and keep on hand copies of MSDSs for commonly-used pesticides. Such MSDSs contain precise information on risks and risk mitigations for each pesticide product, and include measures to take in case of an accidental spill, fire or poisoning. MSDS information can also be used during training.
- As this PERSUAP is amended, Pakistan assistance projects managers will need to report to USAID changes to less toxic products on the list of pesticides recommended to USAID.

## 3.2 FACTOR B: BASIS FOR SELECTION OF PESTICIDES

This procedure generally refers to the practical, economic and/or environmental rationales for choosing a particular pesticide. In general, best practices and USAID – which promote IPM as policy – dictate that the *least toxic* pesticide that is effective is selected. Many farmers choose pesticides based on what is available, how much it costs, if it works well and if it is recommended by a neighbor or farm input store employee. So, this PERSUAP recommends that the bases for selection include human safety, environmental and GAP concerns.

Agriculture (Crop Seeds, Field Crops and Greenhouse Crops)

Up until recently, the bases for selection of pesticides have most often been availability, efficacy, and price; not environmental or human safety. Farmers have wanted a pesticide that has rapid knock-down action to satisfy the need to defeat the pest quickly and visibly. They want to see the pest immediately drop on its back with legs twitching and flailing in the air as it dies.

Farmers who will use GAP and processors who will use HACCP systems for export crops or high-value local markets will focus more on factors such as human safety and low environmental impact, by necessity as much as by choice. Such lower toxicity pesticides may take longer to kill the pest – usually after the farmer has left the field – but they are effective, nevertheless. Another factor of importance is the abeyance of pesticide-specific PHIs (pre-harvest intervals) and MRLs (maximum residue levels), which can be influenced by choosing products with rapid post-application degradation.  The most common bases for traditional farmer and other pesticide selection for crops in Pakistan are past experience, neighborhood farmers, pesticide company extension agents and pesticide dealers.  Other factors include price, availability and efficacy.

Individual pesticides are generally formulated specifically for each of the above uses, and will be labeled for use on seed or for use in greenhouses. Some pesticides found in Pakistan are formulated and labeled specifically for seed treatment; however the demand and market for specifically-labeled greenhouse pesticides is too small, so no specially formulated greenhouse pesticides are available.  In any case, this PERSUAP reviews the most common greenhouse pesticides used world-wide in proactive anticipation of markets expanding sufficiently that greenhouse production increases in Pakistan.

Food Security Treatments and Fumigation of Warehouses

Pesticides and fumigants used for treating stored grains and foods are generally well-known in the sector, and are relatively few.  Selection is based on what is available, recommended, affordable and efficacious against the pests at hand.  Further, the World Food Program (WFP) has specifications and guidelines (Standard Operating Procedures) on which pesticides/fumigants to use and how to use them safely[32].  Non-gas warehouse treatments also have specific best practices found at http://fcamin.nic.in/admin/an4.pdf.

UN's Codex Alimentarius Commission

The Codex Alimentarius Commission was created in 1963 by FAO and WHO to develop food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Program.  The main purposes of this Program are protecting health of the consumers and ensuring fair trade practices in the food trade, and promoting coordination of all food standards work undertaken by international governmental and non-governmental organizations, and its website is www.codexalimentarius.net.

Veterinary for Livestock

Very few pests like disease-transmitting ticks and some biting flies affect livestock and likewise there are few specific insecticides and miticides available for treatment.  Most are synthetic pyrethroids due to relative safety of these products over other classes of pesticides.  Animal treatment antibiotics, microbials and chemicals are listed and analyzed in Annex 8.  Efficacy and cost are the major factors in pesticide selection.

Water and Sanitation

The primary chemicals used in Pakistan for water treatment are based on chlorine.  Additional chemicals that can less commonly be used include those based on other halogens like bromine, iodine, as well as ozone and hydrogen peroxide.  Wikipedia provides a very nice summary of water treatment and some mitigation measures at http://en.wikipedia.org/wiki/Water_purification.  Mitigation measures are found at: http://www.americanchemistry.com/100years/Practices.html.  Water and sanitation chemicals are chosen based upon past experience and cost.

[32] http://foodquality.wfp.org/FoodSafetyandHygiene/PestManagement/Fumigation/tabid/322/Default.aspx?PageContentID=531

Avian Influenza Disinfectants and Sanitizers

Because Avian Influenza and water disinfection are controlled by governments and donors, selection is made by them, generally not by beneficiaries. EPA's list of 100 disinfectant pesticide products registered for use against HPAI in the USA is at: http://www.epa.gov/pesticides/factsheets/avian_flu_products.htm.

Disinfectants are chosen depending upon cost and availability.

Health/Malaria

Malaria control programs are controlled by governments and donors, so pesticide selection is made by them, generally not by beneficiaries. Pesticide selection precedents are set by each donor, according to their environmental policies. USAID has produced Programmatic Environmental Assessments for malaria control[33] and ITNs[34]. Pesticides are often chosen based on their persistence as well as low resistance by malarial mosquitoes.

Construction

Termiticides are chosen based on what is available and safest. Permitted termiticides are included in Annex 7 along with field insecticides and are also listed at the end of Annex 1, under Construction Site Termite Control.

## ISSUE: MOST BENEFICIARIES DO NOT CONSIDER FACTORS SUCH AS:

- Reducing risks to human health by using products that contain active ingredients with low acute human toxicity and few to no chronic health risks;
- Reducing risks to scarce and valuable water resources on the surface and underground;
- Reducing risks to biodiversity and environmental resources, and the services they provide;
- Risks of resistance development by using the same pesticide over and over.

Recommendations for Mitigation

- Choose and use pesticides with low human and environmental risk profiles (see decision matrix in Annex 7, MSDSs, and pesticide labels), as practical.
- Pakistan assistance projects staff be aware of biological and naturally-derived pesticides, as practical, such as those listed in Annexes 4 and 5, and that are available.

[33] http://pdf.usaid.gov/pdf_docs/PNADI081.pdf
[34] http://pdf.usaid.gov/pdf_docs/PNACP696.pdf

- During training courses, include training on pesticide selection factors based on findings and recommendations of this report, material found in MSDSs and pesticide labels, and material found on pest management websites (like UC Davis IPM site found at: http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html) which can emphasize the importance of pesticide selection factors safety and environment.

## 3.3 FACTOR C: EXTENT TO WHICH THE PROPOSED PESTICIDE USE IS, OR COULD BE, PART OF AN IPM PROGRAM

USAID promotes training in, and development and use of, integrated approaches to pest management tools and tactics whenever possible. This section emphasizes how the proposed pesticides used can be incorporated into an overall IPM strategy. All sectors examined have IPM tactics, including numerous non-synthetic pesticide tactics and tools available.

The susceptibility of crop plants to pests and diseases is greatly influenced by the general health of the plant (or livestock), as discussed above in Section 1.5. Therefore, good crop management practices can strongly affect IPM, and good agronomic or cultural practices are the most basic and often the most important prerequisites for an effective IPM program. A healthy crop optimizes both capacity to prevent or tolerate pest damage while maintaining or increasing yield potential.

The USDA supports several programs aimed at investigating and developing IPM tools and tactics, including the National Institute of Food and Agriculture (NIFA)[35] and the National Sustainable Agriculture Information Service of the National Center for Appropriate Technology (NCAT)[36]. This Programmatic Umbrella PERSUAP highlights preventive as well as curative IPM practices in Annex 1. USAID projects in agriculture can use this information to make seasonal crop production and protection plans to predict, prevent and control production constraints (pests/diseases).

### ISSUE: MOST PAKISTAN BENEFICIARIES ARE NOT AWARE OF ALL OF THE IPM TACTICS AVAILABLE

Agriculture (Seed, Field and Greenhouse)

The table below shows status of use of GAP and IPM tools and techniques in Pakistan

[35] http://www.csrees.usda.gov/pesticides.cfm
[36] http://www.attra.ncat.org/

| GAPs/IPM/Tools | Pakistan level | | | FATA-Program Area | | | |
|---|---|---|---|---|---|---|---|
| | Use in Pakistan | Practiced at Farmer Level | Practiced at Institutio-nal Level | Use in Program Area | Practiced at Farmer Level | Practiced at Institutio-nal Level | Remarks |
| **Soil nutrient, texture and pH testing** | Slightly | Nil | Yes | No | Nil | Yes | |
| **Plant resistant/tolerant seed** | Greater extent | Yes | Yes | Greater extent | Yes | Yes | |
| **Seed treatment with pesticide** | Medium level | Nil | Yes | Negligible | Nil | Yes | |
| **Solar soil sterilization** | slightly | No | Yes | No | No | NO | |
| **Raised-bed planting technique** | Greater Extent | Yes | Yes | Greater extent | Yes | Yes | |
| **Plastic or organic mulches** | Slightly | No | Yes | No | No | No | |
| **Follow seeding rate & thinning recommendations** | Greater extent | Yes | Yes | Greater extent | Yes | Yes | |
| **Soil moisture measurements** | Greater extent | Yes | Yes | Greater extent | Yes | Yes | |
| **Use of organic fertilizers (manure, compost)** | Greater level | Yes | Yes | Greater extent | Yes | Yes | Farm yard manure is used mostly |
| **Use of purchased mineral fertilizers** | Greater extent | Yes | Yes | Greater extent | Yes | Yes | |
| **Combinations of organic** | Greater | Yes | Yes | Greater extent | Yes | Yes | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **and mineral fertilizers** | extent | | | | | | |
| **Crop rotation** | Greater extent | Yes | Yes | Greater extent | Yes | Yes | |
| **Pest monitoring with yellow sticky traps** | Slightly | No | Yes | No | No | No | |
| **Use of green manure crops** | Medium extent | Yes | Yes | No | No | No | |
| **Early/late plantings/harvestings to avoid pests** | Slightly | Yes | Yes | Slightly | No | Yes | |
| **Use of trap crops to trap and destroy pests** | Slightly | Yes | Yes | No | No | No | |
| **Pruning and sanitation of diseased plants/trees** | Greater extent | Yes | Yes | Greater extent | Yes | Yes | |
| **Planting parasite-attracting plants on field margins** | Slightly | Yes | Yes | No | No | No | |
| **Inter-planting crops with aromatic herbs (celery, cilantro, parsley) that repel pests** | Slightly | No | Yes | No | No | No | |
| **Farmer ability to correctly identify pests** | Medium | Yes | Yes up to greater extent | Slightly | Yes | Up to medium extent | |
| **Farmer ability to correctly identify predators, parasites and diseases of pests** | Medium | Yes at low level | Yes at high level | Slightly | No | Yes at medium level | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Weekly field scouting to assess pest levels/damage** | Slightly | Yes | Yes | No | No | No | |
| **Mechanical weed control by hoe or tiller** | Greater extent | Yes | Yes | Greater Extent | Yes | Yes | |
| **Use of herbicides for weed control** | Medium extent | Yes | Yes | Slightly | Yes | Yes | |
| **Mechanical pest control by hand picking** | No | No | No | No | No | No | Very rarely by some farmers and research institution for research purpose |
| **Spot treatment of pest hotspots with pesticides (instead of area or entire field spraying)** | No | No | No | No | No | No | Slightly used by institution for research purpose |
| **Use of pheromone traps to monitor moth pest levels** | Slightly | No | Yes | No | No | No | |
| **Use of pheromone inundation to confuse moth mating** | No | No | No | No | No | No | |
| **Sanitation, pruning and crop residue destruction at end of season** | Medium level | Yes | Yes | Slightly | Yes | Yes | |
| **Apply local artisanal plant extracts to kill pests** | Slightly | No | Yes | No | No | No | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Do things to encourage predator/parasite build-up** | Slightly | No | Yes | No | No | No | |
| **Any soil, water, energy, or biodiversity conservation practices** | Medium | Yes at low level | Yes | Slightly | Yes at low level | Yes at low level | |

Some of the beneficiary farmers, whether or not they understand the IPM philosophy fully, do know about, and use some GAP and IPM tools and tactics. The information in this table shows plenty of room for improvement and use of additional tools and techniques. Beyond this, Annex 1 shows a Crop-Pest-IPM-Pesticide matrix for each crop to be assisted by Pakistan assistance projects, most major pests of each crop, and a list of tools and tactics used for the same pests in developed countries, and recommended to be tried and adopted.

## FOOD SECURITY/FUMIGATION OF WAREHOUSES

Unfortunately no integrated storage network exists in Pakistan, resulting in huge post-harvest losses at this stage. In case of grain crops numbers of factors are responsible for loss during storage including evaporation and absorption of moisture by grain, temperature, rainfall, insects, rodents, birds, molds, condition of grain at the time of storage and length of storage period. Of all these, the major loss causing agents are the insects and their attack is directly related to moisture content and type of storage structure. Generally in bins and house type godowns, the incidence of pest attack is roughly 1-2 per cent. In godowns owned by the commission agents or private dealers the damage varies from 5-15 per cent. The insect pest attack vary from 0-18 per cent in wheat, 1.6 to 7 per cent in rice, 1 to 10 per cent in pulses and 2 to 10 per cent in maize sorghum and millet depending upon the type of storage (bulk or bag), whether treated or untreated and on the period of storage (Qamar 1998). In private store houses anti sprouting chemicals such as maleic hydrazide, chlorpropham/CIPC and nonyl alcohol are used on potatoes for better shelf life. Fumigation is also done to manage insect and rodents before and even during storages.

IPM is present through sanitation of the warehouse. Sanitation is the primary non-pesticide tactic that will prevent and keep pest populations under control so they do not require treating with pesticides, or require fewer treatments. Several sanitation best practices, tools and tactics for pests of cereals, small grains and dry beans/peas are included in Annex 1. Following that, Annex 7 contains chemicals (identified by a "W" for warehouse in column 3) that are commonly used for treating warehouses, either via fumigation with gasses, spraying with other chemicals or use of rodenticides in bait boxes. Methyl bromide is being phased out internationally, due to its impact on the earth's ozone layer, and should not be used on any USAID project.

Surveys show that the following warehouse IPM tools and tactics are used in Pakistan:

- Sanitation/Cleaning up of all residues
- Good aeration of commodities
- Multiple management tactics are combined

- Fumigant applicators are trained and certified
- Use of sophisticated Personal Protection Equipment for fumigant use
- Use of fumigant-specific chemical meters for fumigant levels detection

Areas that can use improvement include sanitation, routine monitoring, risk benefit analyses, accurate pest identification and knowledge of stored product biology, ecology and behavior.

## VETERINARY LIVESTOCK TREATMENTS

Livestock veterinary pesticides, marked with a "V" in Annex 7, column 3, can be integrated with other tactics including: hand-picking ticks, fly baits, disease vaccines, using natural extracts of Camphor, as well as the Euphorb (*Euphorbia candelabrum*) milky latex against ticks, Solanaceous (*Solanum incanum*) alkaloid extracts against ticks, and neem leaf aqueous extracts against endoparasites. Other shrub and tree gums, resins and salts can be rubbed on animals to repel ticks.

Water and Sanitation

Integrated Pest Management per se does not necessarily apply to water and sanitation. However, best practices do apply, and there are non-chemical means to disinfect or sanitize water. These include the use

of ultraviolet radiation, solar treatment and membrane filtration. Other techniques include those based on mechanical and biological processes, as follows[37]:

- mechanical systems: sand filtration, lava filter systems and systems based on UV-radiation
- biological systems including plant systems as constructed wetlands and treatment ponds (sometimes incorrectly called reedbeds and living walls) and
- biological systems including compact systems as activated sludge systems, biorotators, aerobic biofilters and anaerobic biofilters, submerged aerated filters, and biorolls

In order to purify the water adequately, several of these systems are usually combined to work as a whole. Combination of the systems is done in two to three stages, namely primary and secondary purification. Sometimes tertiary purification is also added.

Avian Influenza/Disinfectants and Sanitizers

The international—as well as many national—strategies being implemented to deal with HPAI already form an integrated program. In addition to control of the HPAI virus, most initiatives include monitoring and surveillance, zoning and compartmentalization, regulations and quarantine, vaccination, disinfection and disposal of waste[38].

[37] http://en.wikipedia.org/wiki/Water_purification#Other_mechanical_and_biological_techniques

## HEALTH/MALARIA

USAID's PEA[39] for malaria control contains numerous IVM tactics that can be used in concert with pesticides for mosquito control. Future USAID projects that work on malaria should follow the PEA. IVM tactics include:

Interventions targeting adult mosquitoes

- Use of screens on home windows and doors to exclude mosquitoes.
- Indoor residual spraying (IRS) using WHO-recommended pesticides.
- Insecticide-treated nets (ITNs).

Interventions targeting mosquito larvae

- Environmental management methods, including filling breeding sites, lining water sources and canals, physical wetland drainage, biological wetland drainage, impoundment planning, deepening and narrowing of old drains, vegetation manipulation, synchronized cropping and intermittent irrigation, larvivorous fish introduction, and saltwater flooding.
- Larvicidal agents, including bacterial larvicides, methoprene, temephos, and molecular films and oils.

## CONSTRUCTION

IPM applies to both malarial mosquito control, discussed above, and termite control. IPM measures for termite control are included at the end of Annex 1.

Recommendations for Mitigation

- USAID Pakistan project field staff assist with the production of sector and crop-specific Production and Pest Management Plans (PPMPs), using the attached Annex 1 containing Crop-Pest-IPM-Pesticide suggestions for all major pests on all crops/livestock/other, organized by crop phenology or seasonality, and developed into field technical flyers or posters.
- During training and field visits by Pakistan assistance projects field staff, enhance understanding of, and emphasis on, IPM/IVM philosophy, tools and techniques for each crop-pest combination, with synthetic pesticide use as a last resort and choice of least toxic alternatives.

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[38] http://www.oie.int/animal-health-in-the-world/web-portal-on-avian-influenza/

[39] http://pdf.usaid.gov/pdf_docs/PNADI081.pdf (note that a new updated IVM PEA is being drafted in 2011)

## 3.4 FACTOR D: PROPOSED METHOD OR METHODS OF APPLICATION, INCLUDING THE AVAILABILITY OF APPLICATION AND SAFETY EQUIPMENT

This section examines how the pesticides are to be applied, to understand specific risks with different application equipment available and application methodologies, and the measures to be taken (repeated training especially of younger future farmers, and use of PPE) to ensure safe use for each application type. Pesticides can and do enter the body through the nose and mouth as vapors, through the skin and eyes by leaky sprayers, mixing spillage/splashing and spray drift, and mouth by accidental splashing or ingestion on food or cigarettes.

### AGRICULTURE SEED TREATMENT

Typical pesticides and chemicals used for treating seed in Pakistan are listed above under Section 2.4. Ideally, seed would be treated in a specialized "seed treater" composed of a mixing tank, treater head and coating chamber to apply precisely measured quantities of pesticide. However, most farmers are mixing the seed and pesticide in buckets, wheelbarrows or other large receptacles, which leads to uneven application and coverage of seed. Gloves should be used for seed mixing and handling.

### FIELD CROPS

Although there are a wide variety of crops included under the cropping systems of the Pakistan, many small- and medium-holder vegetable farmers still use hand-pump and motorized backpack sprayers with hand-held lances for application, which are prone to leaks at parts junctions and thus applicator exposure risk. Some orchards and plantations use tractor-drawn orchard air-blast, vertical and horizontal boom sprayers, as well as fixed mixing tank and pump sprayers with long hoses attached to hand-operated application lances. Some farmers with more complex application equipment keep hand-pump backpack sprayers for limited 'spot' applications of specific chemicals such as herbicides for areas missed by boom applications.

Although most Pakistan farmers do not generally use PPE, Pakistan assistance projects-supported beneficiaries will be promoting their use as a best practice. Pesticide labels should provide guidance on appropriate PPE to use, and EPA has guidance on a website[40].

### GREENHOUSE CROPS

Most project pesticides in greenhouses will be applied by hand-pumped backpack sprayers (liquids) or a few by hand (powders and granules). Although most Pakistan farmers do not use PPE, Pakistan assistance projects-supported beneficiaries will be promoting their use as a best practice. Pesticide labels should provide guidance on appropriate PPE to use, and the EPA website noted above can be referenced.

### FOOD SECURITY/WAREHOUSES

[40] http://www.epa.gov/oppfead1/safety/workers/equip.htm

Warehouses are treated primarily by fumigation gasses or solid tablets that produce toxic gas once exposed to air and humidity. Fumigation, only if done only by a trained and equipped fumigation service, and not by USAID project-supported farmers (*absolutely requires two trained and certified-level fumigators for each fumigation event*):

- Use a continuous monitoring and detection program to check for and ID pests
- In the USA, "persons who are not trained and certified for the use of grain fumigants should not attempt to fumigate stored grain"
- Follow the aluminum phosphide label to determine correct amount of chemical to use per cubic meter of infested food commodity
- Calm warm day with no wind and temperature above 16 degrees (and not less than 4 degrees) Celsius
- Learn & follow all safety regulations
- Have *two trained people* present for safety
- Plan to finish fumigation in 15-20 minutes maximum
- Post warning signs on all doors
- Use tape and 4 ml polyethylene sheeting
- Leave only necessary holes for putting aluminum phosphide tablets or gas from gas generator and quickly sealing them
- If using tablets, use probes to put tablets around (not in) grain sacks and pallets
- Remove webbing if Indian meal moth larvae are present
- Use proper respiratory protection equipment (self-contained oxygen or canister filter) for *both* fumigators
- Use phosphine gas detection devices
- Absolutely no phosphine tablets or residues come into direct contact with wheat flour.

Other pesticide applications are by hand-pumped backpack sprayers (liquids) or a few by hand (powders). Rodenticides should be applied in closed bait boxes with visible warnings. See reference above for selection of appropriate PPE.

VETERINARY

Many ranchers and herders apply acaricides using backpack sprayers and some use a rag soaked in pesticides and applied using bare hands. These livestock farmers should be encouraged to keep and use chemical-resistant gloves for these purposes. Some ranchers and herders use dip-baths for livestock have fallen out of use and favor. See reference above for selection of appropriate PPE.

Water and Sanitation

Drinking water sanitizers are generally applied by a water treatment facility. Best practices for handling, applying and reducing risks from water sanitizers are found through the Asian Development Bank[41].

Avian Influenza/Disinfectants and Sanitizers

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[41] http://www.adb.org/Evaluation/case-studies/2006-AER/Best-Practices-WaterSupply-Sanitation.pdf

Annex 7 contains microbicides registered for use in Pakistan for disinfecting water and for use in HPAI, and identified with a "D" for disinfectant in column 3. Most disinfectants are Class I toxins and are extremely corrosive to eyes, skin and mucous membranes, especially necessitating the use of goggles or eye protection, chemical-resistant gloves, a carbon-filter respirator and a spray suit to protect clothing and skin. For this reason, most microbicides/disinfectants are shaded yellow for caution. For water treatment, water is exposed to a disinfectant while it is pumped through a treatment facility. Disinfectants for Avian Influenza are often applied by bucket and mop or hand brush.

The best information on how to apply the disinfectants safely will be found on the product or container labels. In the USA, EPA requires that all products have labels containing application and safety procedures. For products that are registered in the USA, use http://oaspub.epa.gov/pestlabl/ppls.home to see web copies of the labels. Products not registered in the USA are also likely to have labels with the same type of information, as most international standards require.

HEALTH/MALARIA

USAID has produced Programmatic Environmental Assessments to guide safe malaria mosquito control including IRS[42] and ITNs[43]. IRS is accomplished using back-pack sprayers with wands. Most IRS application staff members are required to wear PPE in order to do, and keep, their jobs. If LLITNs are used, then there will be no need to re-treat bed nets with pesticides. If only ITNs are available, then retreatment should only be done by WHO-trained and certified individuals with recommended PPE. Area-spraying using large vehicles and fogging equipment to kill mosquitoes has fallen out of use, due to risks and pesticide waste.

CONSTRUCTION

Pesticides applied to standing water to control malarial mosquitoes and to building foundations to control termites are applied by back-pack sprayers and impregnated granules. Respirators and gloves should be used.

## ISSUE: LEAKY BACK-PACK SPRAYERS

Hand-pump backpack sprayers, used by the poorest farmers among others, can and do eventually develop leaks at almost every junction (filler cap, pump handle entry, exit hose attachment, lance attachment to the hose and at the lance handle) and these leaks soak into exposed skin. Clothing serves to wick and hold these pesticides in contact with skin, and to concentrate them use after use, until washed.

Recommendations for Mitigation

- Pakistan USAID assistance projects, especially those dealing with agriculture, as part of its provision of inputs, should include budget allocations for repair and maintenance of application equipment, and develop a management program that includes oversight of repair and maintenance by a selected member of a farmer cooperative or association.

[42] http://pdf.usaid.gov/pdf_docs/PNADI081.pdf
[43] http://pdf.usaid.gov/pdf_docs/PNACP696.pdf

## ISSUE: PESTICIDE GRANULES AND POWDERS APPLIED BY HAND

Most farmers that use pesticides formulated as granules or powders apply these by hand, without benefit of gloves. Gloves should be used for these applications, especially granules as these are often highly toxic chemicals like carbofuran (which should not be used by Pakistan assistance project farmers unless glove use can be assured).

Recommendations for Mitigation

- Pakistan USAID assistance projects ensure that farmers that use powders or granules do so only with gloves.

## ISSUE: PAKISTAN FARMERS DO NOT USE PPE

Reasons that many Pakistan farmers do not use PPE to reduce pesticide exposure risks include:

1. Farmers and workers either discredit or do not completely understand the potential health risks associated with pesticides. Since they have not associated health problems with pesticide exposure they continue to take risks;

2. Climatic conditions (particularly heat) make it uncomfortable to use the safety equipment (despite the fact that it is recommended that many pesticides should be applied very early in the morning when it is cool and there is a lack of wind and rain);

3. Appropriate PPE (especially carbon cartridge respirators necessary for filtering organic chemical vapors) equipment is generally not available at all and if it is available, it is too expensive;

4. Farmers may not understand either the warning labels or pictograms provided on the pesticide labels.

Most pesticide containers, on each pesticide label, either list or put pictograms showing PPE that is recommended for use of that certain product.

Recommendations for Mitigation

- Training under Pakistan assistance projects should include descriptions of health risks to spray operators, their families, and their village (see risks for each pesticide AI in Annex 7).
- Training should include advice on minimizing discomfort from wearing PPE, like spraying in late in the afternoon or evening.
- Ensure that (i.e., budget for) protective clothing (carbon-filter respirator mask, gloves, frequently-washed long-sleeved shirt and pants or Tyvec outfit, boots, and goggles if indicated on the label) recommended for the most commonly-used pesticides are available to farmers and farm workers involved with pesticide use. General examples of PPE to be used for different types of pesticide are found in the following website: http://www.epa.gov/oppfead1/safety/workers/equip.htm.
- Provide training on the need for exclusion times and zones for areas that are being or have been sprayed. Include information about sensitive populations (pregnant women, children, elderly and sick).

- Put into place sprayer equipment maintenance procedures, proper spray techniques that reduce sprayed area walk-through, as well as frequent washing of application clothing.
- Considering illiteracy issues, training should use and explain pictogram representations. Some general mitigation measures to ensure safe pesticide use are contained in Chapter 13 of the following website: http://pdf.usaid.gov/pdf_docs/PNADK154.pdf.
- Set out a schedule for, and budget for, repeated training in safe handling and use of pesticides – including aspects such as types and classes of pesticides, human and environmental risk associated with pesticides, use and maintenance of PPE, understanding information on labels and proper disposal of packaging. Ensure that training 'sticks' by developing a system to certify trained farmers for safe use.

## 3.5 FACTOR E: ANY ACUTE AND LONG-TERM TOXICOLOGICAL HAZARDS, EITHER HUMAN OR ENVIRONMENTAL, ASSOCIATED WITH THE PROPOSED USE, AND MEASURES AVAILABLE TO MINIMIZE SUCH HAZARDS

This section of the PERSUAP examines the acute and chronic toxicological risks associated with the proposed pesticides.

The pesticide matrix in Annex 7, columns 6, 7 and 8 contain information on acute and chronic human toxicological risks for every pesticide AIs found in Pakistan, or likely to be imported to or used in all seven of the sectors that this PERSUAP covers. And, column 9 contains information on the potential for each AI to pollute ground (drinking) water. With a couple of exceptions, USAID projects should not permit the use of pesticides in Annex 7 containing AIs that are WHO Classes Ia or Ib, EPA Class I, or known to be carcinogens or water pollutants, marked in red, and should only cautiously, with additional research, permit those shaded in yellow.

Annex 7, columns 10-18, contains information on relative eco-toxicity, if known, of each AI to several important terrestrial and aquatic organisms. USAID-supported projects must make pesticide choice decisions biased toward those pesticides with lower human and environmental risks. Nevertheless, pesticides are poisons, and nearly all of them present acute and/or long-term toxicological hazards, especially if they are used incorrectly.

### ISSUE: PESTICIDE ACTIVE INGREDIENTS ON POPS AND PIC LISTS

The Stockholm Convention on Persistent Organic Pollutants (POPs) and Rotterdam Convention's Prior Informed Consent (PIC) procedure which list banned and highly regulated toxic chemicals, respectively, were not known when Regulation 216 was written, so there is no language directly governing their use on USAID projects. Nevertheless, they present high risks to users and the environment, due to persistence and toxicity. It is thus prudent that they be discussed. Pakistan signed the POPs treaty on December 6, 2001 and ratified it on April 17, 2008. Pakistan ratified the PIC treaty on July 14, 2005.

The following websites contain current lists of all POPs and PIC chemicals: http://www.pic.int; http://www.pops.int. Endosulfan which has been regulated (June 2010) for phase out and ban in the USA, and which was just (2011) added to the POPs list, is still registered for use in Pakistan (see Annex 7, under insecticides). No USAID project should permit endosulfan to be purchased or used.

The Montreal Protocol, described on http://www.epa.gov/ozone/intpol/ finds the soil and warehouse fumigation chemical methyl bromide slated for phase out internationally and in the USA[44]. No USAID project should permit methyl bromide to be purchased or used.

Recommendations for Mitigation

- None of these POPs or PIC chemicals, listed on the POPs and PIC websites, including endosulfan, or methyl bromide, should be used on Pakistan assistance projects beneficiary demonstration farms.

## ISSUE: VERY HIGH ACUTE TOXICITY

A few of the pesticides found in Pakistan contain active ingredients that are EPA Class I or WHO Class Ia or Ib (the highest toxicities by mg/kg of body weight), which are *too toxic for small- and medium-scale (USAID's target), unaware and uninformed farmers to use*. These very highly acutely toxic pesticide AIs are found highlighted in red color in Annex 7. Less toxic alternatives, including preventive tactics and tools (Annex 1), and several curative pesticide choices, including some that are less toxic than Class I chemicals (Classes II, III and IV for instance), also found in Annex 1, exist, and should thus be used in place of Class I pesticides.

Recommendations for Mitigation

- With the exception of rodenticides and aluminum phosphide used by trained experts, Pakistan assistance projects's beneficiaries should not use products containing active ingredients that are WHO Class 1a or 1b, or EPA Class I acute toxicity (see Annex 7, red color shading).

## ISSUE: MODERATE ACUTE TOXICITY

All pesticide products that have at least acute WHO and EPA toxicity ratings of II (see Annex 7) are considered to be *too toxic for use without farmer training and proper use of PPE*.

Recommendations for Mitigation

- Products containing active ingredients with Classes III or IV acute toxicity ratings should be recommended over Class II pesticides (see Annex 7).
- Moreover, recommendations should not be made to use such products unless it can be ascertained that appropriate training and PPE are available *and will be used*.

Recommendations for Mitigation of Human Toxicological Exposures

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[44] http://www.epa.gov/ozone/mbr/; http://mbao.org/mbrqa.html#q6

Most pesticide poisonings result from careless handling practices or from a lack of knowledge regarding the safer handling of pesticides. Pesticides can enter the body in four major ways: through the skin, the mouth, the nose, and the eyes. Chapter 13 in the resource http://pdf.usaid.gov/pdf_docs/PNADK154.pdf contains measures to reduce risks of exposure via oral, dermal, respiratory and eyes. The time spent learning about safer procedures and how to use them is an investment in the health and safety of oneself, one's family, and others.

- Pakistan assistance projects field staff should encourage the demonstration farmers and beneficiaries with whom they work as partners to not use POPs or PIC products or products containing very highly toxic active ingredients.
- Train beneficiaries and provide posters/flyers on pesticide safe-use BMPs. For each group of farmers to be trained, identify the pesticides most likely to be used on their specific crops, and then identify the human health risks associated with each by using information on pesticide labels, in the attached Annex 7, and on MSDSs.
- Provide training on, and follow basic first aid for pesticide overexposure. Train managers and farmers on basic pesticide overexposure first aid, while following recommendations found in Chapter 13 of http://pdf.usaid.gov/pdf_docs/PNADK154.pdf, as well as any special first aid information included on labels and MSDSs for commonly-used pesticides.

Recommendations for Mitigation of Exposures to Environmental Resources

Ecotoxicological exposures can be mitigated by adhering to the following do's and don'ts:

**Do's**

- Emphasize and use IPM practices in crop production
- Read and follow pesticide label instructions
- Choose the pesticide least toxic to fish and wildlife (see Annex 7)
- Protect field borders, bodies of water and other non-crop habitats from pesticide
- Completely cover pesticide granules with soil, especially spilled granules at the ends of rows
- Minimize chemical spray drift by using low-pressure sprays and nozzles that produce large droplets, properly calibrating and maintaining spray equipment, and use of a drift-control agent
- Properly dispose of chemical containers (provide training on what this means locally)
- Maintain a 2.5 to 5 km buffer no-spray zone around national parks, water bodies or other protected areas
- Warn beekeepers of upcoming spray events so that they may move or protect their hives

**Dont's**

- Do not spray over ponds and drainage ditches
- Never wash equipment or containers in streams or where rinse water could enter ponds or streams
- Do not use pesticides with potential or known groundwater risks near drinking water sources, or where the water table is less than 2 meters, and on sandy soils with high water tables

- Do not apply pesticides in protected parks
- Do not use aerial applications near sensitive habitats
- Do not spray when wind speeds are more than 13 to 16 kph
- Do not apply granular pesticides in fields known to be frequented by migratory waterfowl
- Do not apply insecticides from 10 am to 4 pm when honeybees are foraging; insecticides are best applied late in the afternoon when it is cooler (or at night) with no wind or rain, and when honeybees do not forage

## 3.6 FACTOR F: EFFECTIVENESS OF THE REQUESTED PESTICIDE FOR THE PROPOSED USE

This section of the PERSUAP requires information similar to that provided previously, but more specific to the actual conditions of application and product quality. This section considers the potential for use of low-quality generic products (such as many of those imported from China and a few from India) as well as the development of pest resistance to proposed pesticides, both of which will decrease effectiveness (efficacy). The issues and mitigations will be the same for all of the sectors covered.

Annex 7, in column 2, provides the class or type of chemical in each pesticide AI in order for USAID project implementers to be able to recommend that farmers rotate among different classes of chemicals to counter the development of resistance by pests and diseases.

Agriculture Seed Treatment, Field Crops and Greenhouse crops

Local knowledge is essential to choosing the correct pesticides. Local farmers know what has or has not worked for them in the past, and Pakistan assistance projects can increase local knowledge as to what is available, possibly effective, and presents the lowest risk.

Resistance of pests to pesticides used on Pakistan assistance projects crops will likely occur with increased pesticide use. Farmers in most countries over-dose and under-dose and use non-selective pesticides, all of which increases chances for resistance development. The primary tool in the battle against resistance is rotation by class or type among available chemicals (using information in Annex 7), combined with the use of preventive IPM tools and tactics.

Food Security/Warehouses

Managing stored grain pest resistance to certain insecticides is a major challenge to this sector[45]. There are even insects that have developed resistance to deadly phosphine gas[46]. Most food security pesticide applicators trained by the UNWFP will know the insect, mite and other pest species that have developed resistance to certain pesticides or classes of pesticides. And, they will know the alternative effective pesticides available for rotation.

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[45] http://ipm.illinois.edu/pubs/iapmh/05chapter.pdf
[46] http://bru.gmprc.ksu.edu/proj/iwcspp/pdf/9/kps41.pdf

Veterinary

Pathogen, insect and tick resistance to vaccines/antibiotics/medicines, insecticides and acaricides, respectively is a major challenge facing veterinary technicians. Fully 41% of pest resistance occurs in the veterinary field[47]. The primary tool in the battle against resistance is rotation among available chemicals (using information in Annex 7), combined with the use of preventive IVM tools and tactics.

Water and Sanitation

Although microbial resistance to antibiotics like pharmaceuticals is well known, resistance by microbes to highly toxic disinfectants is rare. Furthermore, chlorine compounds used for treating water are highly effective and this is the reason that they continue to be used to the present time. These microbicides and disinfectants remain effective.

Avian Influenza/Disinfectants

Fortunately, most disease-causing viruses have not developed resistance to most disinfectants. The HPAI virus is not omnipresent and thus is not continuously exposed to disinfectants to which it might develop some resistance. However, it is still a good idea to rotate disinfectants to reduce the chance of resistance.

Health/Malaria

Unfortunately, malarial mosquitoes are developing resistance to many of the insecticides used against them. Most WHO-trained malaria control technicians recognize the need to rotate among pesticide classes and products.

Construction

Construction crews can gain advice on malaria control products and resistance from the local malaria control board. Many termiticides are relatively new. To reduce the development of resistance by termites to termiticides, mixes of termiticides can be used containing chemicals from different classes (see Annex 1).

## ISSUE: LACK OF KNOWLEDGE AND INFORMATION ON PESTICIDE EFFECTIVENESS

At some point, Pakistan assistance projects field staff and demonstration farmers may begin to note that some products no longer work well to control pests in their field, and will likely begin to blame pesticide manufacturers for a weaker product. This could be the development of insecticide resistance, and it could be the result of improper dosing. Farmers should be trained to monitor for the development of insecticide resistance, and Pakistan assistance projects implementers should be on the lookout for it during their field visits.

Recommendations for Mitigation

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[47] http://science.jrank.org/pages/48691/Pesticide-Resistance.html

- Through training, Pakistan assistance projects field staff increase local knowledge on pesticides available, possibly effective, and present the lowest risk.
- Teach farmers and other beneficiaries to rotate pesticides to reduce the build-up of resistance.

Monitor resistance by noting reduction in efficacy of each pesticide product

## 3.7 FACTOR G: COMPATIBILITY OF THE PROPOSED PESTICIDE USE WITH TARGET AND NON-TARGET ECOSYSTEMS.

This section examines the potential effect of the pesticides on organisms other than the target pest (herein called critical resources). Non-target species of concern include fish, honeybees, birds, earthworms, aquatic organisms, and beneficial insects. The potential for negative impact on non-target species should be assessed and appropriate steps identified to mitigate adverse impacts; and this would be included in the Pakistan assistance projects' EMMPR.

Annex 7 shows, in columns 10-18, the relative known risks to the types of terrestrial and aquatic organisms referred to above for each pesticide active ingredient found in pesticide products discovered likely to be used in Pakistan in each of the seven sectors covered by this PERSUAP, so that informed product choices can be made if the pesticide is to be used in or near sensitive areas or resources. Maps below show natural resources.

### ISSUE: FOREST RESOURCES, BIODIVERSITY CONSERVATION AND PROTECTED OR ENDANGERED SPECIES

**Forest resources in Pakistan**

The following forest types are found in Pakistan[48]:

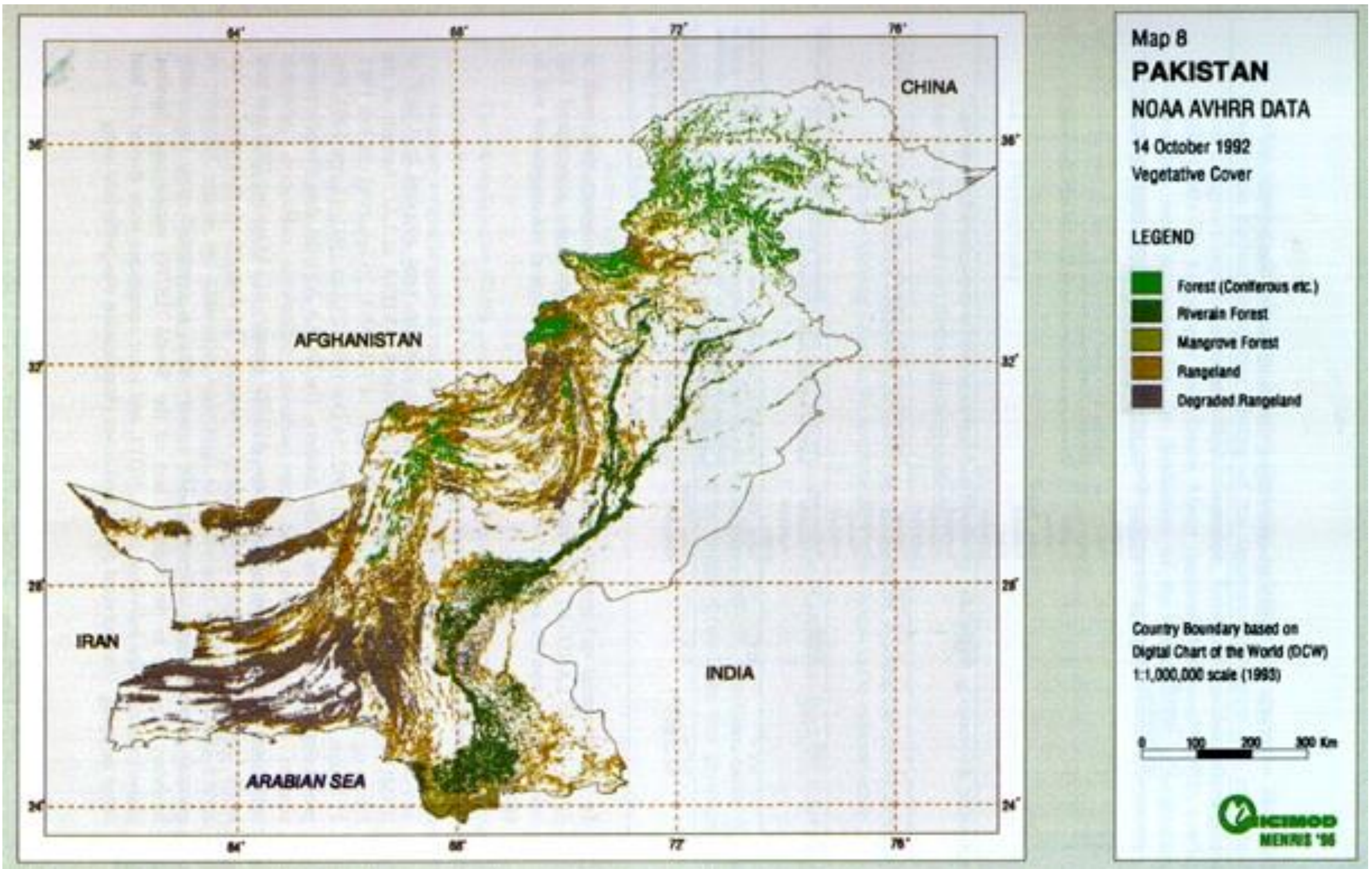
- Littoral and Swamp forests
- Tropical dry deciduous forests
- Tropical thorn forests
- Sub-tropical broad-leaved evergreen forests
- Sub-tropical pine forests
- Himalayan moist temperate forests
- Himalayan dry temperate forests
- Sub-alpine forests
- Alpine scrub

[48] http://www.wildlifeofpakistan.com/IntroductiontoPakistan/forestsofPakistan.htm

The figure below shows Pakistan vegetative cover, including forests.  True forest cover follows rivers and mountain valleys, also with rivers and water.  Unfortunately, forest resources are harvested for multiple purposes and these highly-fertile lowland areas are planted with crops and treated with pesticides and synthetic fertilizers.

Figure: Pakistan Vegetative Cover Highlighting Forests (UNEP)

No USAID project should permit the use of pesticides in or near (5km from) protected areas, parks forests, waterways or water bodies, wetlands or swamps.



## PAKISTAN PROTECTED AREAS

There are three types of areas that have been declared as protected:

- National Parks
- Wildlife Sanctuaries
- Game Reserves

The National Parks are only meant for recreational purposes where no other activity can take place. In Wildlife Sanctuaries, no hunting is allowed as they have the endangered wildlife species. As for the Game Reserves, hunting is allowed but only in certain months in a year and after a hunting permit has been obtained from the Wildlife Department. In Pakistan, there are 225 protected areas composed of 14 National Parks, 99 Wildlife Sanctuaries and 96 Game Reserves. They occupy a large 10.4% of the land area (9,170,121 ha) of Pakistan.

### SUMMARY OF PROTECTED AREAS IN PAKISTAN (BASED ON PAKISTAN NCCW DATA) [49]

| Region/Province | National Parks | Wildlife Sanctuaries | Game Reserves | Un- Classified | Total PAs | Total Area Conserved | % of Total Land Area |
|---|---|---|---|---|---|---|---|
| Azad Jammu Kashmir | 1 | 0 | 8 | 0 | 9 | 51,998 | 3.91 |
| Balochistan | 2 | 15 | 7 | 7 | 31 | 1,837,704 | 5.29 |
| Punjab | 2 | 37 | 19 | 0 | 58 | 3,315,803 | 16.14 |
| NWFP | 3 | 6 | 38 | 5 | 52 | 470,675 | 6.30 |
| Sindh | 1 | 35 | 14 | 4 | 54 | 1,307,575 | 9.27 |

[49] National Council for Conservation of Wildlife; http://www.wildlifeofpakistan.com/WildlifeBiodiversityofPakistan/protectedareassystemofPakistan.htm

| Region/Province | National Parks | Wildlife Sanctuaries | Game Reserves | Un- Classified | Total PAs | Total Area Conserved | % of Total Land Area |
|---|---|---|---|---|---|---|---|
| Federal Territory | 1 | 1 | 1 | 0 | 3 | 94,186 | 100 |
| Northern Areas | 4 | 5 | 9 | 0 | 18 | 2,092,180 | 2.97 |
| Totals | 14 | 99 | 96 | 16 | 225 | 9,170,121 | 10.40 |

The first national park, Lal Suhanra, was formally declared in the Bahawalpur district of Punjab in 1972. The park consists of irrigated forest plantations (20,974 acres), desert branch pond (4780 acres) and Cholistan Desert (51726 acres) for a total of 77480 acres. The park was established to protect existing wildlife and vegetation; reintroduce extirpated species; rehabilitate wildlife habitat; create education/research facilities for local and foreign tourists, and recreational facilities for the local population.

Kirthar National Park achieved its protected status in 1973. Established in the Dadu district of Sindh, this 466,000 acre reserve provides protection for a fine herd of ibex about 60 miles north of Karachi. Other large game species such as Indian gazelle and urial sheep have increased their populations within the park. A management plan has been drawn up for the park with the assistance of the World Conservation Union (IUCN). However, fiscal restraints and other priorities have largely precluded full implementation of the plan.

Khunjerab in northern Hunza, Gilgit Agency, became the third national park in 1975. This area has been successful in providing protection for the Marco Polo's sheep, blue sheep, snow leopard, snowcock, snow partridge and other high mountain species.

National parks in Pakistan have apparently been established primarily for wildlife and not necessarily for their historic or scenic features. Their administration is handled by the provincial wildlife departments.
So far, 15 national parks have been declared.

No USAID project should permit the use of pesticides in or near (5km from) protected areas, parks, wildlife sanctuaries and preserves, forests, waterways or water bodies, wetlands or swamps.

## PAKISTAN BIODIVERSITY

According to the World Wildlife Fund (WWF), the following represents the biodiversity present in Pakistan.

## Flora

About 5,500 - 6,000 species of vascular plants have been recorded in Pakistan including both native and introduced species. The flora included elements of the 6 phytogeographic regions. Four monotypic genera of flowering plants and around 400 (7.8%) species are endemic to Pakistan. Almost 80% of the endemics are found in the northern and western mountains. The Kashmir Himalayas are identified as a global centre of plant diversity and endemism. Families with more than 20 recorded endemics are Papilionaceae (57 species), Compositae (49), Umbelliferae (34), Poaceae (32) and Brassicaceae (20).

## Mammals

Around 174 mammal species have been reported in Pakistan. Out of these, there are at least 3 endemic species and a number of endemic and near endemic sub-species.

## Birds

Six hundred and sixty eight bird species have been recorded in Pakistan. Out of them, 375 were recorded as breeding. Breeding birds are a mixture of Palearctic and Indomalayan forms (one-thrid) and the occurrence of many species at one or the other geographical limits of their range shows the diverse origins of the avifauna. The Sulaiman Range, the HinduKush, and the Himalayas in the NWFP and Azad Kashmir comprise part of the Western Himalayan Endemic Bird Area; this is the global centre of bird endemism. The Indus Valley wetlands are the second area of endemism.

## Reptiles/Amphibians

Around 177 species or reptiles and amphibians, being a blend of Palearctic and Indomalayan forms, are found in Pakistan. Out of the total 14 species of turtles, 90 of lizards and 65 of snakes have been reported. Thirteen species are believed to be endemic. Being a semi arid country, only 22 species of amphibians have been recorded, of which 9 are endemic.

## Fish

Pakistan has 198 native and introduced freshwater fish species. The fish fauna is predominately south Asian and with some west Asian and high Asian elements. Fish species diversity is highest in the Indus river plains and in adjacent hill ranges (Kirthar Range), and in the Himalayan foothills in Hazara, Malakand, Swat and Peshawar. Diversity is lowest in the mountain zone of the northern mountains and arid parts of north-west Balochistan. There are 29 endemic species.

## Invertebrates

There has been little research on Invertebrates of Pakistan. About 5,000 species of invertebrates have been recorded including insects (1,000 species of true bugs, 400 species of butterflies and moths, 110 species of flies and 49 species of termites). Others include 109 species of marine worms, over 800 species of mollusks and 355 species of nematodes.

One large biodiversity "hotspot" includes the Himalaya Range Hotspot, as shown below. Any projects operating within this range in Pakistan should limit pesticide use, and use the pesticides with the lowest toxicities to organisms shown in Annex 7, columns 10-18.


Himalaya Hotspot[50]

## ISSUE: PESTICIDE PERSISTENCE

The effect of each pesticide on non-target ecosystems will depend on how long it stays in the environment, or rather its rate of break-down, or half-life. Half-life is defined as the time (in days, weeks or years) required for half of the pesticide present after an application to break down into degradation products. The rate of pesticide breakdown depends on a variety of factors including temperature, soil pH, soil microbe content and whether or not the pesticide is exposed to light, water, and oxygen.

Many pesticide breakdown products are themselves toxic, and each may also have a significant half-life. Since pesticides break down with exposure to soil microbes and natural chemicals, sunlight and water, there are half-lives for exposure to each of these factors.

In the soil, types and numbers of microbes present, water, oxygen, temperature, pH, and soil type (sand, clay, loam) all affect the rate of breakdown. Most pesticides also break down, or photo-degrade, with exposure to light, especially ultraviolet rays. Lastly, pesticides can be

50 http://www.biodiversityhotspots.org/xp/hotspots/himalaya/Pages/default.aspx

broken down, or hydrolyzed, with exposure to water. Pesticides with a long residual period (that are labeled persistent and last for years) include atrazine herbicide and organochlorine pesticides. Many of the newer carbamate, organophosphate and synthetic pyrethroid pesticides break down much quicker, generally within weeks, in the environment.

Recommendations for Mitigation

- Consider the toxicity, half-life and breakdown products of pesticides during the selection process, and choose pesticides that are less toxic and break down quickly in the environment.
- Avoid using pesticides in or within a 2km buffer zone from protected areas or national parks and where endangered species are known to exist.
- If agricultural production is done within 10km up-wind or up-stream from a protected area, investigate the use of botanical and biological controls, as practical, or produce Organic crops near these valuable natural resources.
- Apply pesticides early in the morning before honeybees forage. Do not apply during heavy rains or winds. Follow instructions on pesticide packaging.
- Apply pesticides at least 35 meters from open water.

## 3.8 FACTOR H: CONDITIONS UNDER WHICH THE PESTICIDE IS TO BE USED, INCLUDING CLIMATE, GEOGRAPHY, HYDROLOGY, AND SOILS

In general, in addition to element G above, this requirement attempts to protect natural resources from the dangers of pesticide misuse and contamination, especially of groundwater resources. The following conditions apply, regardless of pesticide use sector, and thus the information here covers all seven sectors.

### PAKISTAN CLIMATE

Depending on the topography, there is an extreme variation in the temperature of Pakistan. The country is essentially arid except for the southern slopes of the Himalayas and the sub-mountainous tract where the annual rainfall varies between 760 and 1270 mm. This area has humid sub-Tropical climate. In the extreme north - because of great heights - Highland climate prevails. The controlling factors of the climate are:

1. The sub-Tropical location of Pakistan that tends to keep the temperature high, particularly in summer.

2. The oceanic influence of the Arabian Sea that keeps down the temperature contrast between summer and winter at the coast.

3. Higher altitudes in the west and north that keep the temperature down throughout the year.

4. The Monsoon winds that bring rainfall in summer.

5. The Western Depression originating from the Mediterranean region and entering Pakistan from the west that brings rainfall in winter. These cyclones make a long land journey and are thus robbed of most of the moisture by the time they reach Pakistan.

6. A temperature inversion layer at a low elevation of about 1,500 m in the south during the summer, which does not allow the moisture-laden air to rise and condensation to take place.

## PAKISTAN RAINFALL

The major part of Pakistan experiences dry climate. Humid conditions prevail but over a small area in the north. The whole of Sindh, most of Balochistan, the major part of the Punjab and central parts of Northern Areas receive less than 250 mm of rainfall in a year. Northern Sindh, southern Punjab, north-western Balochistan and the central parts of Northern Areas receive less than 125 mm of rainfall. True humid conditions appear after the rainfall increases to 750 mm in plains and 625 mm in highlands. The figure below shows the precipitation patterns in Pakistan.

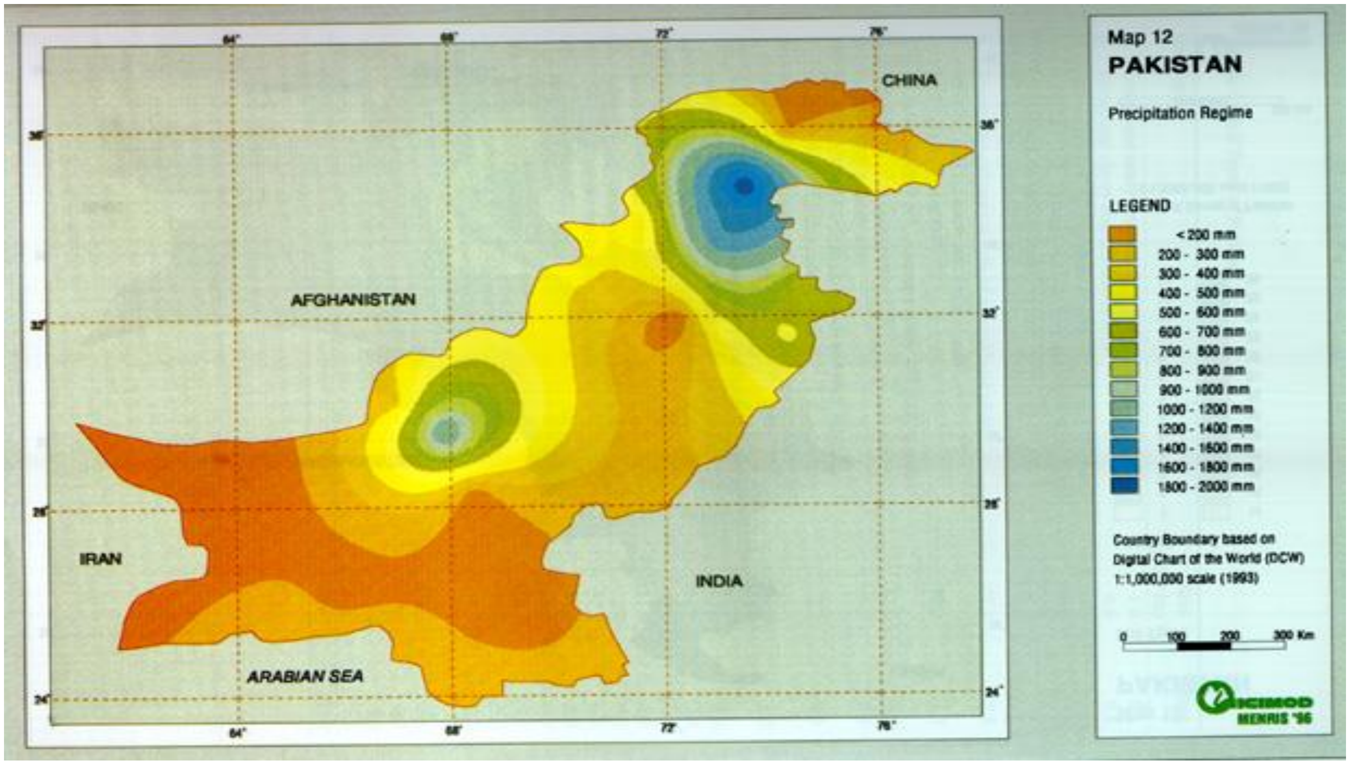



Figure: Precipitation Patterns in Pakistan (UNEP)

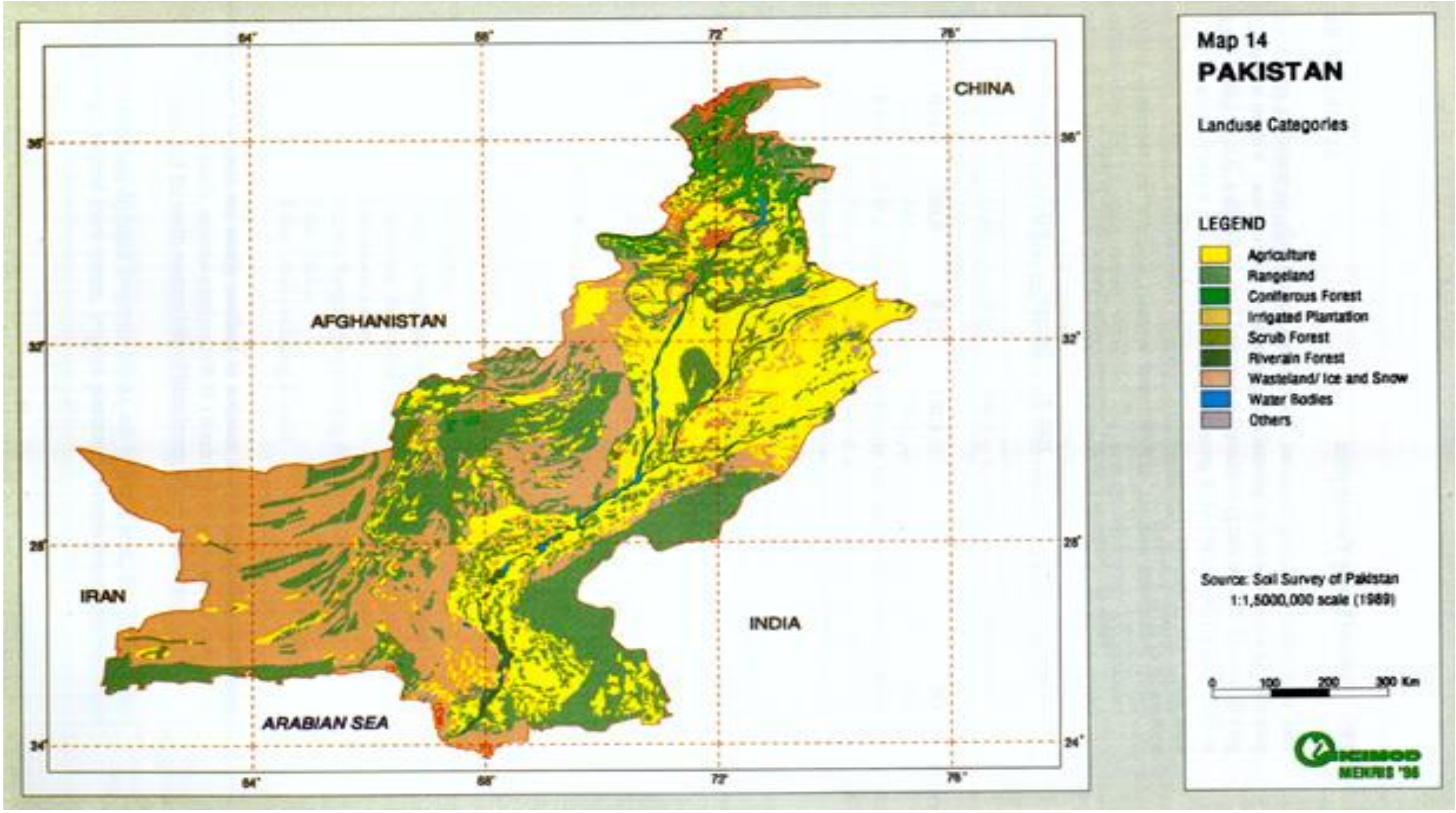
## PAKISTAN LAND USE

For the purpose of this study, the land area of Pakistan can be divided into five major categories: Reported Area; Forest Area; Cropped Area, Cultivable Waste; Unreported Area. The data, though dated, and in need of an update to the 2000s, has a time interval of 46 years: sufficient to determine the changed land use pattern, if any.

### LAND USE PATTERN OF PAKISTAN (MILLION HA)

| **Category** | 1947-48 | 1993-94 | % Change |
|---|---|---|---|
| Geographical Area | 79.61 | 79.61 | 0.00 |
| Reported Area | 47.43 | 58.12 | + 7.79 |
| Forest Area | 2.84 | 3.44 | + 21.13 |
| Cropped Area | 14.60 | 22.15 | + 22.92 |
| Cultivable Waste | 11.50 | 8.84 | - 16.84 |
| Unreported Area | 32.18 | 21.49 | - 16.35 |

The figure below presents the Land use Categories for the four provinces of Pakistan.  Compared to the data provided by the Forest and Agriculture Departments, the data of Soil Survey Department differs in almost all the land use categories. This warrants a serious re-classification of the present land use status.



## FIGURE: MAP OF LAND USE PATTERNS IN PAKISTAN

According to a map prepared by the Soil Survey of Pakistan (published in 1988), nine major land use classes have been identified, as identified in the Table below.

### LAND USE CATEGORIES OF PAKISTAN (000' HA)

| Land Use Type | Area (000' ha) | Percentage |
|---|---|---|
| 1. Agriculture | 21,733 | 27.3 |
| 2. Rangelands | 25,475 | 32.0 |
| 3. Coniferous Forests | 1,353 | 1.7 |
| 4. Irrigated Plantations | 80 | 0.1 |
| 5. Scrub Forests | 796 | 1.0 |
| 6. Rain Forests | 239 | 0.3 |
| 7. Wastelands including areas under Ice and Snow | 28,501 | 35.8 |
| 8. Water Bodies (rivers only) | 1,274 | 1.6 |
| 9. Others | 159 | 0.2 |
| TOTAL: | 79,610 | 100.0 |

Pakistan Geography

The geography of Pakistan is a profound blend of landscapes varying from plains to deserts, forests, hills, and plateaus ranging from the coastal areas of the Arabian Sea in the south to the mountains of the Karakoram Range in the north. Pakistan geologically overlaps both with the Indian and the Eurasian tectonic plates where its Sindh and Punjab provinces lie on the north-western corner of the Indian plate while Balochistan and most of the Khyber-Pakhtunkhwa lie within the Eurasian plate which mainly comprises the Iranian Plateau, some parts of the Middle East and Central Asia. The Northern Areas and Azad Kashmir lie mainly in Central Asia along the edge of the Indian plate and hence are prone to violent earthquakes where the two tectonic plates collide.

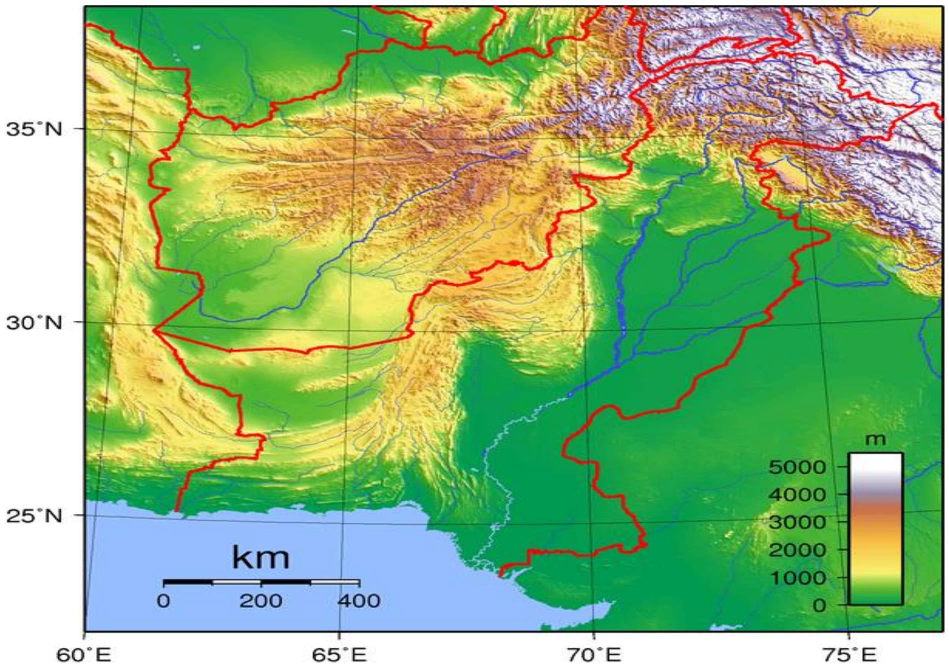


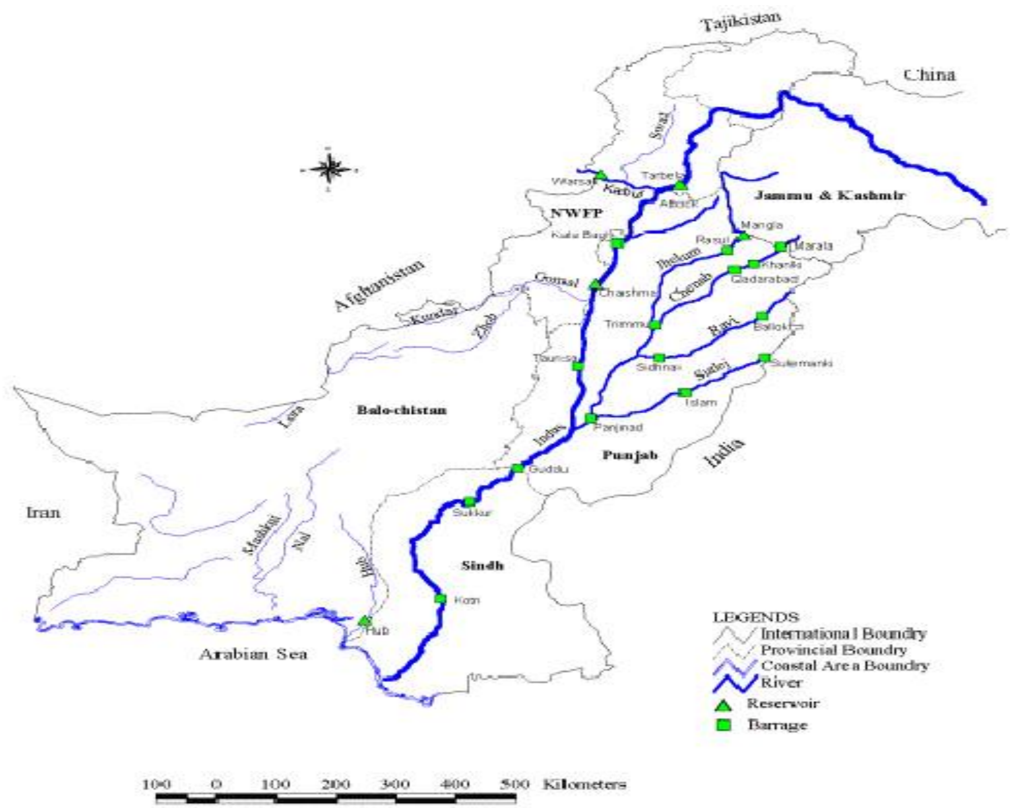
*Figure: Topography of Pakistan*

The topographic map above shows the three major geographic areas: northern highlands, Indus River plain, and Balochistan Plateau.  Pakistan is bordered by Afghanistan to the north-west and Iran to the west while the People's Republic of China borders the country in the north and India to the east. The nation is geopolitically placed within some of the most controversial regional boundaries which share disputes and have many-a-times escalated military tensions between the nations, e.g., that of Kashmir with India and the Durand Line with Afghanistan. Its western borders include the Khyber Pass and Bolan Pass that have served as traditional migration routes between Central Eurasia and South Asia.

**Pakistan Hydrology**

The Indus River is the 12th largest river in the world and drains through most of Pakistan. Pakistan is heavily dependent on the river as a major source of water supply. This dependence on a single river system is a cause for concern especially as the Indus River is also a trans-boundary river shared by India. The teeming populations of these countries demand for water continues to rise and the supply from the river is no longer sufficient to meet the demand. Groundwater availability in this region is also on the decline. Over-exploitation of the groundwater in many areas is now causing the quality to decline. Groundwater accounts for over 40% of the irrigation needs of the region.  Water from the Indus River is relied upon to provide potable drinking water to the 130 million people, generate power and fill the gap in irrigation demand. Dams on the main stem of the Indus River and its tributaries produce most of the electrical energy for Pakistan (45%).

*Figure: Pakistan Rivers*[51]




The Indus River originates from the Karakoram, Hindukush, and the Himalayan regions along the north and north eastern borders of Pakistan. The rivers flow south towards the Arabian Sea with a combined annual average volume of 178 bcm (for all major rivers) discharged into the Indus Plains. The Indus River system forms a link between two large natural reservoirs, the snow and glaciers in the mountains and the groundwater contained by the alluvium in the Indus Plains of the Sindh and Punjab Provinces of Pakistan.

The Indus Basin comprises of the Indus River, its five major left bank tributaries the Jhelum, Chenab, Ravi, Beas and Sutlej Rivers, one major right bank tributary the Kabul. The Indus Waters Treaty of 1960 apportions the flows of four main rivers to Pakistan, the Indus, Kabul, Jhelum, and Chenab Rivers, and the remaining three to India - Ravi, Beas and Sutlej. Because of the socio-economic importance of this river, its study is important to provide information needed for its management, and to ensure that it is sustainable and able to continue support the population and environmental flows.

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[51] http://www.wildlifeofpakistan.com/IntroductiontoPakistan/riversofPakistan.htm

## THREATS TO WATER RESOURCES

According to WWF[52], there are various threats and problems to the water resources and their management in this region. Some of them can be enumerated as follows:

- Demand: According to government estimates, the population of Pakistan is expected to grow by 2.1 % over the next 25 years. The population of the Northern Areas is set to grow even faster, that is, by 2.5% per annum. This means that the water availability for agriculture needs to grow by at least 30% in the next ten years just to maintain the present level of usage per capita. Within the domestic sector increase in demand will be higher, that is, almost 50% over the next decade, because of accelerated urbanization and increased domestic water usage in rural communities (GoP & IUCN, 2003). The town of Gilgit itself is expected to reach almost 200,000 by the year 2020 (Raza, 2002).

Therefore if proper management of water and development of additional water resources is not adequately carried out, there could be a perceptible shortage of this resource with serious implications for the economy of the region.

- Pollution: Increasing pollution is threatening the water supply of the region. This increase is coming from the pressure of population increase. As mentioned before, water in the towns and villages is generally not potable except where well water is used or where interventions have reduced contamination. For example, two of the major water channels that are the source of drinking water to the town of Gilgit have become open sewers from the effluent and other human-generated waste running into it. Here many houses situated along the water channels dump their garbage right into the channels due to lack of proper disposal facilities. In rural areas also, the pollution of water channels is a problem. Raza (1997) has catalogued the fecal content of traditional water channels in area villages and this has been discussed earlier in this report.

Water pollution is also increasing from increased chemical fertilizer use in the region. For example, in the Gilgit district almost 93% of the farmers now use chemical fertilizers.

## SOILS OF PAKISTAN

According to UNEP, The soils of Pakistan are derived from two types of parent materials:

1. Alluvium, Loess and wind reworked sands. They are of mixed mineralogy; and 2. Residual material obtained from weathering of underlying rocks. Most of the rocks are Calcareous. In some areas, Granites have produced non-calcareous soil material. Very small quantities of salts are released from most of the rocks. The soils are therefore, essentially non-saline. The figure below depicts the major soil types of Pakistan, and is matched with Pakistan soil type classifications shown in the following soil type table.

Soil Classification: The soils of Pakistan have acquired distinct characteristics from the parent material and by their mode of formation. The river-laid sediments have developed into Alluvial Soils. The desert sands have turned into distinct soils. The hills, mountains and the plateaus have produced Residual Soils with patches of Alluvial, Loess and other soils. Accordingly, the soils of Pakistan can be classified into the following six

[52] http://www.wwfpak.org/nap/dnap_freshwater_threats.php

types: Alluvial Soils of the Flood Plains; Alluvial Soils of the Bar Uplands; Soils of the Piedmont Plains; Desert Soils; Soils of Potwar Plateau; and Soils of Western Hills.

The best loamy-clay soils (yellow, number 14) follow the major river systems while rolling to hilly places are dominated by sandy soils (medium brown, number 20) and mountainous regions are dominated by shallow loamy-gravelly soils (light brown, number 23) comprising the largest percentage by areas.

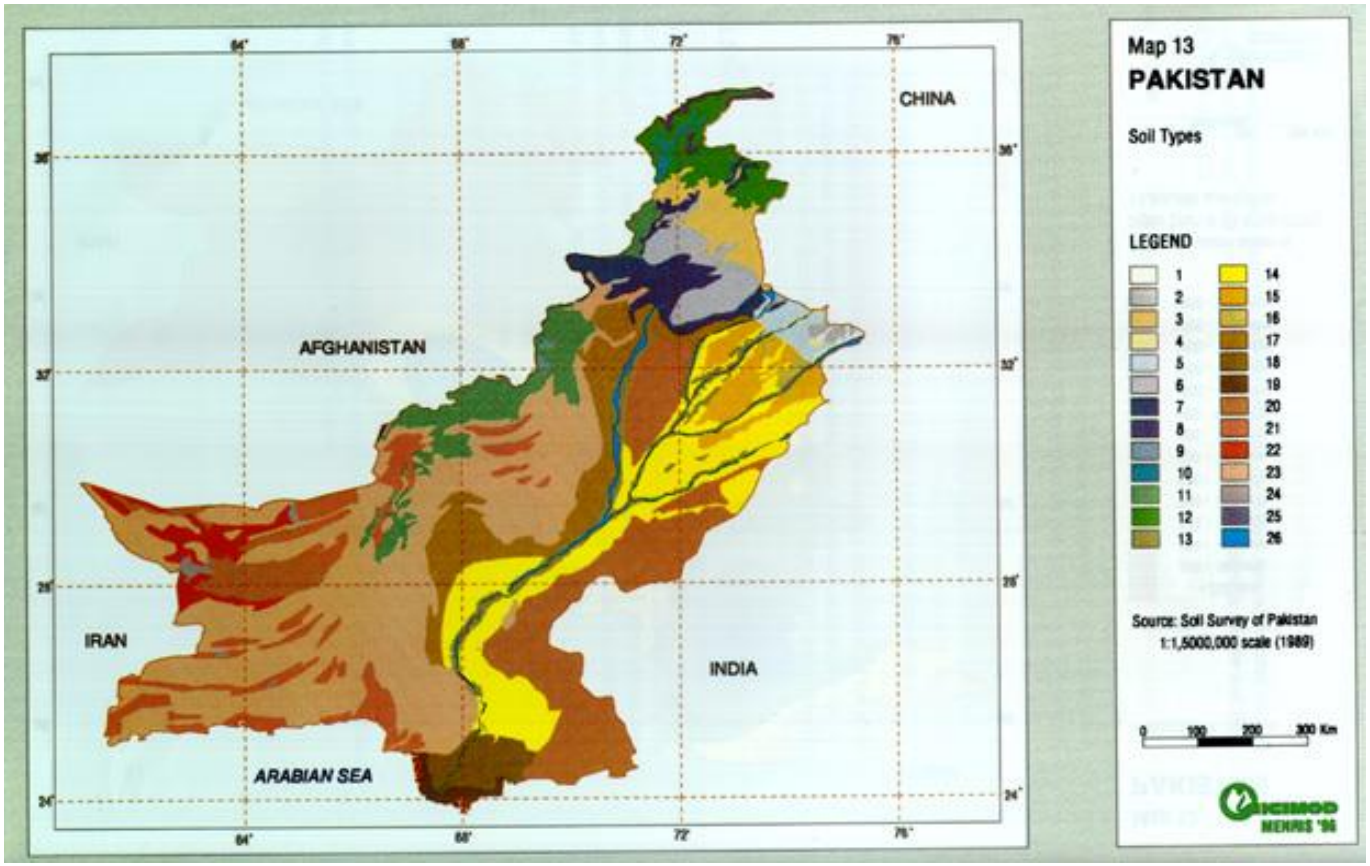


Figure: Soils of Pakistan (UNEP)

| Soil Type | Area (000 'ha) | Percentage |
|---|---|---|
| 1. Loamy and sandy stratified soils | 1.0 | 0.1 |
| 2. Loamy and clayey non-calcareous soils | 4.6 | 0.6 |
| 3. MOUNTAINS: Loamy shallow soils<br>VALLEYS : Loamy non-calcareous soils | 18.6 | 2.3 |
| 4. Loamy sandy stratified soils | 1.5 | 0.2 |
| 5. Loamy clayey non-calcareous soils | 7.7 | 1.0 |
| 6. Loamy non-calcareous soils of alluvial/loess plains | 18.2 | 2.3 |
| 7. MOUNTAINS: Loamy and shallow soils<br>VALLEYS : Loamy soils | 10.2 | 1.3 |
| 8. MOUNTAINS: Rock out-crops loamy and shallow soils<br>VALLEYS : Loamy soils | 17.0 | 2.1 |
| 9. Loamy partly gravelly soils | 0.7 | 0.1 |
| 10. MOUNTAINS: Loamy shallow soils and rock out-crop<br>VALLEYS : Loamy soils | 2.7 | 0.3 |
| 11. MOUNTAINS: Rock out-crop and loamy very shallow soils<br>VALLEYS : Loamy soils | 41.7 | 5.2 |
| 12. MOUNTAINS: Rock outcrop, some loamy very shallow soils<br>VALLEYS : Mainly loamy soils | 22.7 | 2.9 |
| 13. Loamy sandy stratified soils | 18.8 | 2.4 |
| 14. Loamy clayey soils | 90.4 | 11.4 |
| 15. Loamy soils of old river terraces | 21.9 | 2.8 |
| 16. Loamy clayey mainly dense saline sodic soils | 2.0 | 0.3 |
| 17. Loamy and clayey partly saline sodic soils | 52.7 | 6.6 |
| 18. Mainly loamy saline soils | 15.3 | 1.9 |
| 19. Silty and calyey saline soils | 5.6 | 0.7 |
| 20. Rolling to hilly sandy soils | 116.9 | 14.7 |
| 21. Mainly loamy partly gravelly soils | 46.6 | 5.8 |

| Soil Type | Area (000 ‘ha) | Percentage |
|---|---|---|
| 22. Mainly loamy partly gravelly soils | 16.7 | 2.1 |
| 23. MOUNTAINS: Rocky out-crop with patchy soils<br>VALLEYS : Mainly loamy partly gravelly soils | 244.5 | 30.6 |
| 24. Clayey and loamy severely slaine sodic soils | 2.7 | 0.3 |
| 25. Glaciers and snow caps | 3.4 | 0.4 |
| 26. Rivers | 13.0 | 1.6 |
| **TOTAL:** | **796.1** | **100.0** |

## ISSUE: PESTICIDE SOIL ADSORPTION, LEACHING AND WATER CONTAMINATION POTENTIALS

Each pesticide has physical characteristics, such as solubility in water, ability to bind to soil particles and be held (adsorbed) by soil so they do not enter the soil water layers and the ground water table, and their natural breakdown rate in nature. This data can be found for the pesticides discovered in Pakistan by checking each pesticide on the following website: http://sitem.herts.ac.uk/aeru/footprint/en/index.htm. The water solubility, soil adsorption and natural breakdown rates, if available, are included throughout the webpage, for each parent chemical.

In general, pesticides with water solubility greater than 3 mg/liter have the *potential* to contaminate groundwater; and pesticides with a soil adsorption coefficient of less than 1,900 have the *potential* to contaminate groundwater. In addition, pesticides with an aerobic soil half-life greater than 690 days or an anaerobic soil half-life greater than 9 days have the *potential* to contaminate groundwater. Moreover, pesticides with a hydrolysis half-life greater than 14 days have *potential* to contaminate groundwater.

The potential for pesticides to enter groundwater resources depends, as indicated above, on the electrical charge contained on a pesticide molecule and its ability and propensity to adhere to soil particles, but this also depends on the nature and charge of the soil particles dominant in the agriculture production area. Sand, clay and organic matter, and different combinations of all of these, have different charges and adhesion potential for organic and inorganic molecules. Sandy soil often has less charge capacity than clay or organic matter, and will thus not interact significantly with and hold charged pesticide molecules. So, in areas with sandy soil, the leaching potential for pesticides is increased.

A pesticide’s ability to enter groundwater resources also depends on how quickly and by what means it is broken down and the distance (and thus time) it has to travel to the groundwater. If the groundwater table is high, the risk that the pesticide will enter it before being broken down is increased. Thus, a sandy soil with a high water table is the most risky situation for groundwater contamination by pesticides. Groundwater contamination potential for each pesticide active ingredient available in Pakistan is provided in Annex 7.

In areas with highly sandy soils, such as those noted above, pesticides that are known water pollutants, colored in red in Annex 7, as well as pesticides that are “potential” water pollutants, as noted in column 9, should be replaced by pesticides (especially herbicides) that are not potential pollutants.

Recommendations for Mitigation

- Ensure that pesticides labeled for certain types of use environments, or areas, are in fact used according to label recommendations.
- Since transport of pesticides absorbed to soil particles is a likely transportation route to waterways, techniques should be employed to reduce farm soil erosion (such as terracing, employing ground covers between rows, planting rows perpendicular to the slope, using drip irrigation, and so on).
- Do not use herbicides or other pesticides with high leaching and groundwater pollution potential (see Annex 7, column 9) on highly sandy soils or soils with water tables close (2-3 meters) to the surface. Pay particular care when spraying near waterways, so that pesticides do not enter surface water.
- Do not spray synthetic pyrethroid or other pesticides with high toxicities to aquatic organisms before an impending rainstorm, as they can be washed into waterways before breaking down.

## 3.9 FACTOR I: AVAILABILITY OF OTHER PESTICIDES OR NON-CHEMICAL CONTROL METHODS

This section identifies less toxic synthetic (produced in laboratories or factories), as well as non-synthetic or 'natural' (extracts of naturally-occurring plants, spices, oils, fatty acids, induced resistance elicitors, minerals, microbes or microbial extracts) pesticide options for control of pests, and their relative advantages and disadvantages. Many of these 'natural' pesticides can be toxic to humans as well, and several are even in products classified as RUPs due to environmental risks; thus safe pesticide use practices extend to these natural as well as synthetic pesticides.

Agriculture Seed Treatment, Field Crops, Greenhouse crops and Food Security/Warehouses, Construction

Annex 1—the heart of this PERSUAP—contains numerous non-chemical preventive methods for every major pest or disease of every major crop and stored grain crop of Pakistan. It is the intent of this PERSUAP that USAID projects dealing with agriculture and food security use this valuable resource, which compiles all known IPM tools and tactics for each pest.

Veterinary

Annex 1 contains several alternative livestock IPM tools including pesticides. Further, there are several alternate livestock IVM tools and techniques listed above under factor C.

Avian Influenza/Disinfectants

The primary alternatives to disinfectants to control bird flu are containment and quarantine of both infected and uninfected birds, as well as practices found in website noted above under Factor C[53]. The non-chemical alternative to chemical water disinfection is to use radiation, like UV rays.

Health/Malaria

There are several alternate mosquito IVM tools and techniques listed above under factor C.

### ISSUE: NATURAL PEST CONTROLS AVAILABILITY

Natural chemicals: Many non-synthetic chemical IPM tools and technologies are listed in Annexes 4 and 5. The list of natural pesticides likely entering Pakistan is not as extensive as other developing countries. In general, most synthetic nematocides and soil pesticides/fumigants are very highly toxic. However, there are some companies producing next-generation natural chemicals in the USA: Bio Huma Netics, http://www.bhn.name for natural nematocides and Agra Quest, http://www.agraquest.com for bioactive essential oils.

For commercial operations, especially greenhouses, biological controls and beneficial organisms are available commercially from local Biolabs as well as two large international companies, Koppert of Holland and Biobest of Belgium. Koppert provides many biological controls against spider mites, beetles, leaf miners, mealy bugs, thrips, aphids, whiteflies, and moth and butterfly larvae. Koppert also provides the Koppert Side Effects List, a list of the side effects of pesticides on biological organisms, at http://www.koppert.com. Biobest of Belgium provides many of the same or similar biological controls as Koppert, and includes a control against leaf hoppers. Their website is: http://www.biobest.be. These are especially useful for greenhouse and seedling production systems. Both companies also sell live bumblebees for greenhouse pollination assistance.

Recommendations for Mitigation

- As appropriate, USAID projects integrate low-risk natural chemical pest controls that are found available in Pakistan.

## 3.10 FACTOR J: HOST COUNTRY'S ABILITY TO REGULATE OR CONTROL THE DISTRIBUTION, STORAGE, USE, AND DISPOSAL OF THE REQUESTED PESTICIDE

This section examines the host country's existing infrastructure and human resources for managing the use of the proposed pesticides. If the host country's ability to regulate pesticides is inadequate, the proposed action – use of pesticides – could result in greater risk to human health and the environment.

Agriculture Seed Treatment, Field Crops, Greenhouse crops, Food Security/Warehouses and Veterinary

[53] http://www.oie.int/animal-health-in-the-world/web-portal-on-avian-influenza/

The Ministry of Agriculture in Pakistan has produced updated pesticide regulations and an up-to-date list of permitted pesticides for agriculture, veterinary and warehouse pest control. Pakistan has reasonable research, extension and enforcement services, except in areas like FATA. Border crossings are less controlled than optimal, leading to the entry of generic Chinese products of variable quality.

Avian Influenza/Disinfectants and Health/Malaria

The parts of the government that deal with Avian Influenza and Malaria control have international guidelines that they use for controlling the distribution, storage, use and disposal of pesticides specific for each sector.

## ISSUE: LIMITED RESOURCES TO CONTROL PESTICIDES

Pakistan has limited systems and resources enforcing the registration and regulation of the import, sale and use of pesticides. Further, their ability to cover the country and eliminate banned or highly toxic chemicals is limited due to limited resources. The list of pesticides available contain some very highly toxic chemicals that should not be handled by illiterate, untrained, unprotected and often unaware small-holder farmers like those found throughout Pakistan. Most farmers do not have access to and cannot afford PPE in order to follow GAPs.

## ISSUE: ILLEGAL PRODUCTS FROM NEIGHBORING COUNTRIES

"Leaky" country border crossings could be likely sources of pesticides that are not officially registered in Pakistan. Some PIC chemicals have been found in formal and informal markets in the region, as have some POPs chemicals.

## ISSUE: DISPOSAL OF PESTICIDE CONTAINERS

Some Pakistani farmers retain empty and partially-full plastic pesticide containers. Some use them to store water. Before disposal, the standard practice has been to triple-rinse the containers, puncture them to discourage re-use, and bury or burn them. Burning plastic bottles and single-use pesticide sachets can lead to the formation of toxic (and POPs) furans and dioxins, and is not recommended. GlobalGAP and other S&C systems require that empty pesticide containers are triple rinsed over a pesticide soak pit with layered soil, lime and carbon, or a bio-active pit, and then properly stored in plastic drums in the field or storage shed, to await disposal or recycling. There are no pesticide container recycling activities occurring anywhere in Asia. The website http://www.epa.gov/oppfead1/labeling/lrm/chap-13.htm provides pesticide disposal options.

Recommendations for Mitigation

- Pakistan assistance projects staff members encourage and follow developments in the regulation and registration of pesticides in Pakistan.
- Absolutely no POPs or PIC chemicals should be used on Pakistan assistance projects -supported fruit and vegetable production. This includes endosulfan, a POPs Treaty candidate, which is highly popular among vegetable producers the world over, but has killed numerous farmers as well.
- Pakistan assistance projects field staff members encourage and support the use of GlobalGAP best practices with pesticide storage, use and disposal, whether or not certification is required for market access.

## 3.11 FACTOR K: PROVISION FOR TRAINING OF USERS AND APPLICATORS

USAID recognizes that, in addition to the use of PPE, safety training is an essential component in programs involving the use of pesticides. The need for thorough training is particularly acute in developing countries, where the level of education of applicators may typically be lower than in developed countries.

Agriculture Seed Treatment, Field Crops, Greenhouse crops, Food Security/Warehouses and Veterinary

### ISSUE: FARMERS NEED INTENSIVE AND REPEATED TRAINING

Training in Safe Pesticide Use and GAP/IPM are of paramount importance for Pakistan assistance projects farmers, farm laborers and other sector personnel using pesticides. Pakistan assistance projects -supported agriculture activities should focus strongly on providing GlobalGAP, as well as IPM and safe pesticide use training. Additional and refresher training are superb means for affecting beneficiary farmer behavior, now, as they continue to expand their agricultural opportunities, and before risky behaviors become further set. Annex 9 provides a list of training topics appropriate for the agriculture sector.

Avian Influenza/Disinfectants and Health/Malaria

Most government and donor workers who do Avian Influenza or malaria control receive proper training and PPE from WHO and donors.

Recommendations for Mitigation

- Implement GAP, IPM and Pesticide Safe Use training for Pakistan USAID assistance projects staff and beneficiaries.
- Use Annex 1 to produce and promote the use of Pest Management Plans for farmers to anticipate and better manage primary pests.

## 3.12 FACTOR L: PROVISION MADE FOR MONITORING THE USE AND EFFECTIVENESS OF EACH PESTICIDE

Evaluating the risks, impacts and benefits of pesticide use should be an ongoing, dynamic process. Pest resistance is one of the risks for which this element is intended, as well as human health and safety and environmental effects.

Agriculture Seed Treatment, Field Crops, Greenhouse crops, Food Security/Warehouses and Veterinary

Record keeping should track quantities and types of pesticides used. Making notes on effectiveness of individual pesticides and pest numbers will help develop a more sustainable pesticide use plan for each Productive Agriculture Project beneficiary producer. Records of farmers, as well as Pakistan assistance projects agronomists, will need to make note of any reductions in pesticide efficacy experienced, which is the first indication that resistance may be developing, and then a strategy needs to be in place to determine a shift to a different pesticide class, and rotation among classes, to overcome resistance development.

Avian Influenza/Disinfectants and Health/Malaria

Most government and donor workers who do Avian Influenza or malaria control receive proper training on record-keeping from WHO and donors. And, these are more like emergency programs responding to an immediate short-term need. Extensive records are available on both sectors.

## ISSUE: PAKISTAN ASSISTANCE PROJECTS AND FARM RECORD-KEEPING

On Pakistan assistance projects proposed demonstration farms, pesticide use documentation is either non-existent or not retained from year to year. Developing a more systemized approach to record keeping will allow seasonal and annual comparison of pesticide effectiveness, pest numbers, crop production, maintenance of safety equipment, and so on. The following aspects should be included in the record keeping system, for a USAID-funded program:

- Local, EPA and EU regulatory compliance: A list of country, EPA and EU laws related to the use of agrochemicals for plant protection, short notes on the relevance of the law, dates the laws come into or exit force and MRLs for each crop-pesticide combination.
- A pesticide checklist: This list allows agronomists to ensure that the pesticides they are using are not banned by international treaties (POPs, PIC) and registered through the USEPA. It should also provide notes on special safety requirements.
- GAPs/IPM measures tried/used (see Annex 1): Pakistan assistance projects agronomists should try to incorporate a minimum of at least three new IPM measures per annum and document their success or failure.
- PPE: Lists of the types of equipment made available to applicators, number of pieces, prices and contact details of suppliers, dates when equipment needs to be washed, maintained or replaced. PPE should be numbered or personally assigned to applicators to ensure that it is not taken home where (as a contaminated material) it could pose a risk to family members.
- Monitoring/recording pests: Agronomists should incorporate into their records regular field pest monitoring and identification. This could be done by the agronomists themselves, or if properly trained, by farmers.
- Environmental conditions: Field conditions should be incorporated into the record keeping system (for example; precipitation, soil analyses and moisture, soil pH, temperatures and so on).
- Information should be transmitted at least annually and Pakistan assistance projects should report to USAID on this progress in pesticide safety and GAP/IPM use in annual reports.

## ISSUE: MONITORING BY PAKISTAN ASSISTANCE PROJECTS FIELD STAFF AND FARMERS SHOULD DETECT:

- Resistance: Pesticide resistance development among pests has likely occurred and could eventually occur more, and will be noted by farmers complaining that the spray no longer works as it once did.
- Human poisonings and any incidences of chronic health issues.
- Farm animal and livestock deaths.
- Any incidences of water pollution.
- Fish, bird, wildlife or honeybee kills.

Any of the above items should be reported immediately to USAID. Other information should be transmitted at least annually to USAID, and Pakistan assistance projects should report on this progress in pesticide environmental and human health safety in annual reports.

### ISSUE: PAKISTAN ASSISTANCE PROJECTS PLANNING AND REPORTING

Several issues could receive more attention in Pakistan assistance projects annual work plans and annual reports. These include a section on Environmental Impact Mitigation and Best Practices, with subsections (and issues) on:

- Country and EPA regulation compliance (documents and enforcement status, risk, pollution, mitigation)
- GAPs/IPM measures tried/used and on what percent of Pakistan assistance projects farms
- Biodiversity and conservation (soil, water, energy, protected habitats, biodiversity and protected species) measures used on what percent of farms
- Inputs and PPE use and issues (types, amounts and issues with products, sprayers, MRLs, REIs, MSDSs)
- Training/capacity building in IPM and Safe Use (hands-on, demos, sessions, meetings, extension, flyers, brochures, pamphlets, posters, crop technical GAP information sheets, and radio and TV outreach/safety message enforcement)

Recommendations for Mitigation

- Pakistan assistance projects to follow all of the above best practices in monitoring, record-keeping, evaluation/analyses and reporting.
- Site managers/agronomists should develop a record-keeping system, which is also a requirement for GlobalGAP and other international market-driven produce certification systems. It is highly recommended that records are kept in an electronic format for easy editing, updating and modification.
- Using Annex 11, Pakistan assistance projects staff should put plans for monitoring the environmental and human health impact of production activities, following recommendations found in this PERSUAP into the Annual Action Plans.
- Pakistan assistance projects staff keeps records on the implementation of the recommendations found in this PERSUAP, and report on them in Quarterly and Annual Reports, under a heading titled "Environmental Impact Mitigation and Best Practices".

## SECTION 4: PESTICIDE SAFE USE ACTION PLAN (SUAP) FOR PAKISTAN USAID ASSISTANCE PROJECTS

**Action Plan Title: Actions to increase awareness of and mitigate pesticide risks on Pakistan assistance projects sites**

Action Plan Objectives: Reduce risks from pesticides

*On the following Action Plan Matrix, **COP or delegate insert the start and end dates for each activity (see recommendations in Executive Summary for guidance on deadlines) or action or groups of sub-actions or activities to complete the action with the names of those responsible for each action, and a budget.** Once this is action plan is completely filled, and actions are under way or done, it can be transmitted to AID to show Regulation 216 compliance progress reducing pesticide risks on your project.*

| **Actions/Activities** | **Start** | **End** | **Who** | **Budget** |
|---|---|---|---|---|
| **Reiterating Pesticide Restrictions** | | | | |
| Ensure that USAID beneficiaries do not use locally-available insecticides containing banned POPs or PIC chemicals, including endosulfan, or Montreal Protocol chemical methyl bromide | | | | |
| Ensure that USAID beneficiaries do not use fumigant aluminum phosphide to treat stored grain or produce (instead use trained and equipped fumigation services) | | | | |
| USAID projects assign local pesticide commercial product names to Active Ingredients in PERSUAP Annex 7 | | | | |
| Ensure that USAID beneficiaries do not use pesticide products containing active ingredients shaded red in Annex 7 | | | | |
| USAID project staff members check for any movement by the Pakistan MINFAL on registration of pesticides, and obtain information on new pesticide registrations | | | | |
| **Pesticide Risk Awareness and Mitigation** | | | | |

| | | | | |
|---|---|---|---|---|
| USAID projects provide annual training for project staff and beneficiaries using the training topic list in Annex 9 | | | | |
| Ensure that USAID beneficiaries and farmer associations or cooperatives each have 1 or 2 sets of PPE for the group to share; assign responsible PPE caretakers | | | | |
| Ensure that USAID beneficiaries use PPE and apply pesticides only early in the early morning or late afternoon when it is cooler, and when there is no wind or rain | | | | |
| USAID projects annually test and certify pesticide users on knowledge of human safety and environmental protection | | | | |
| **Good Agriculture Practices/IPM** | | | | |
| USAID projects test pest-specific crop-pest-IPM-pesticide information in Annex 1 with beneficiary farmers and food warehouse managers for field use, validation, modification or adaptation | | | | |
| USAID projects use information in Annex 1 to produce crop-specific PPMPs, and then field reference guides or posters for farmers to use to anticipate and manage pests | | | | |
| USAID projects promote the use of artisanal and commercially-available natural chemicals listed in Annexes 1, 4 and 5, as available | | | | |

| | | | | |
|---|---|---|---|---|
| USAID projects follow GlobalGAP standards at http://www.epa.gov/oppfead1/labeling/lrm/chap-13.htm for empty container disposal and pesticide record-keeping | | | | |
| **Project Management Responsibilities** | | | | |
| USAID projects define and assure safe use practices | | | | |
| USAID projects define appropriate methods of pesticide handling, storage, transport, use and disposal | | | | |
| USAID projects keep copies of the current list of pesticide AIs analyzed by this PERSUAP at all project sites | | | | |
| USAID projects collect and keep copies of MSDSs for each commercial pesticide that beneficiaries use at all project sites | | | | |
| USAID projects keep copies of prohibited pesticide products containing active ingredients shaded red in Annex 7 at all project sites | | | | |
| USAID projects keep PERSUAP recommendation implementation records and report on them in Annual Reports, under a heading titled "Environmental Compliance and Best Practices" | | | | |
| USAID projects provide for SUAP enforcement | | | | |

**Action Plan Goals: Decrease the number of farmers or other sector beneficiaries unaware of pesticide safety, environmental and natural resource protection, and IPM concepts**

**Action Plan Discussion:**

**Action Plan Final Sign-off: COP ________________________, date: ________________**

Once filled and signed by COP, this Action Plan can be sent to USAID for project management monitoring purposes, so USAID staff can see the degree to which PERSUAP recommendations are being implemented, issue with implementation, and to set future targets for impacts of pesticide safety activities.